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AIR WAR COLLEGE

RESEARCH REPORT

TRAINING THE WEEKEND WARRIOR
IN THE
CORE AUTOMATED MAINTENANCE SYSTEM

COLONEL JOHN J. CRAWFORD, JR.
ANG

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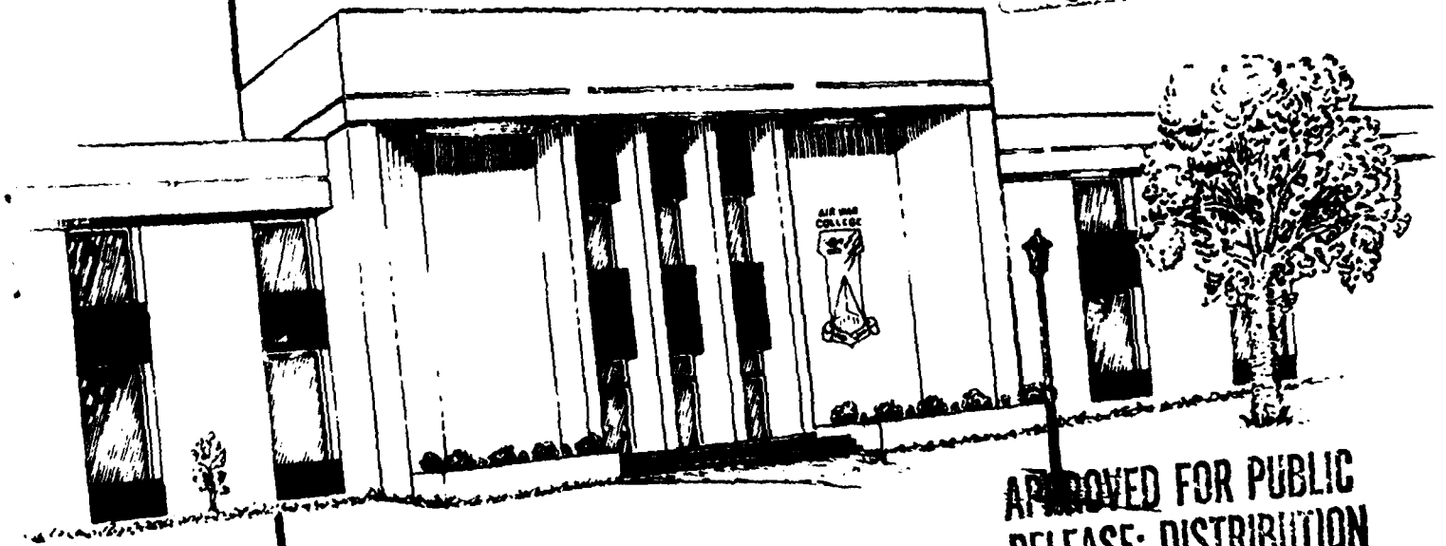

AIR UNIVERSITY
UNITED STATES AIR FORCE
MAXWELL AIR FORCE BASE, ALABAMA

AIR WAR COLLEGE
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TRAINING THE WEEKEND WARRIOR IN THE CORE AUTOMATED MAINTENANCE SYSTEM

by

John Joseph Crawford Jr.
Colonel, ANG

A DEFENSE ANALYTICAL STUDY SUBMITTED TO THE FACULTY

IN

FULFILLMENT OF THE CURRICULUM

REQUIREMENT

Advisor: Colonel John A. Brantner

MAXWELL AIR FORCE BASE, ALABAMA

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EXECUTIVE SUMMARY

TITLE: Training the Weekend Warrior in the Core Automated Maintenance System

AUTHOR: John J. Crawford, Colonel, ANG

An analysis of the unique requirements of training the traditional guardsman (weekend warrior) as it relates to the implementation of the Core Automated Maintenance System in aircraft maintenance. It looks at the marriage of the training conducted by the Air Training Command and those unique training requirements of the traditional guardsman. Shortfalls are identified and an alternative, interactive videodisc instruction, to platform instruction is offered.

BIOGRAPHICAL SKETCH

Colonel Joe Crawford is the Director of Resources, Hq, Kansas Air National Guard, Topeka, Kansas.

Colonel Crawford grew up in Texas and graduated from Laneri High School in Ft. Worth. He graduated from the University of Texas at Arlington, Arlington, Texas in 1966 with a Bachelor of Science Degree in Mathematics. He is a graduate of Air Command and Staff correspondence program and graduated from the Industrial College of the Armed Forces correspondence program in 1987.

Colonel Crawford entered the Air Force Reserve in 1955. In 1959 he became a Flight Engineer on the C-119. He was commissioned in 1964 through the Outstanding Airman program as an Aircraft Maintenance Officer. In 1969 he transferred to the Kansas Air National Guard as an Aircraft Maintenance Administrative Officer. In 1980 he was appointed as the Director of Administration for the 184th Combat Support Squadron. He assumed command of the Combat Support Squadron in 1982. In March 1986 he was appointed Deputy Commander for Resources and assumed command of the Resource Management Squadron. He became the Vice Commander of the 184th Tactical Fighter Group in February 1987. On July 1, 1988 he was appointed the Director of Resources, Headquarters, Kansas Air National Guard, Topeka, Kansas.

Colonel Crawford is a graduate of the Air War College, class of 1989.

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PREFACE

Throughout most of my career I served as a traditional Guardsman (one who trains one weekend a month and fifteen days a year). It has been only the last three years that I have been a full time active duty guard officer. As I moved up the ladder to positions of command I began to wonder if there was a better way to train the traditional guardsman.

As the Combat Support Squadron Commander, the Resource Management Squadron Commander, the Deputy Commander for Resources, and the Vice Commander of a tactical fighter group I began to see significant shortfalls in our training. I am not talking about aircrew training. That area has been addressed very well. My concern is with the support personnel such as, aircraft maintenance mechanics, transportation personnel, supply personnel, food service, etc.. Formal training provided by Air Training Command is difficult to attend for the traditional guardsman because of his availability, length of some of the schools, and training funds available both at the local and national level.

The Total Force Policy and the heavy reliance of the Air Force on the Reserve Components has caused the guard to become more operationally oriented. When this happens the guard supervisors tend to not take time to train the weekend personnel because of the operational commitment. It is quicker to use the fully trained full time work force.

During my years in maintenance, I served as a member, and also chaired the Retention and Recruiting Committee. During those years I had the opportunity to interview many airmen who where not renewing their service contract. These airmen primarily had a first term service commitment. There were many reasons given for not reenlisting but the one most often used was "I really don't have anything to do, they don't trust me to do it." These airmen are referring to the reluctance of the full time supervisor to rely on the week-ender to do a job.

With the technology available today, and the will to use it, the guard can provide the training necessary to build the trust of the full time supervisor. The reserve forces are a strong part of the United States national security policy of deterrence. With all indications showing the next war will be "come as you are", it is imperative the reserve components are highly trained. If it takes three to six months, after mobilization, to get them trained for combat, the war may be over.

According to the Director of the Air National Guard, MG John B Conaway, forty-four percent of the combat capability of the United States Air Force is in the Air Reserve Forces (twenty-six percent guard, eighteen percent reserves). These percentages can also be derived from information found in the 1988, September/October issue of Defense 88 Almanac.

ACKNOWLEDGEMENTS

The material for this paper primarily came from two sources. The preponderance of material was through personal interviews with the people considered to be most qualified in their field. The technical data derived from open literature including books, government publications and professional journals.

There is little written information on the Core Automated Maintenance System. Everything pertaining to this system came from interviews with the developers of the system, the personnel tasked with training the system, and the users of the system.

I am indebted to BG Al Bunting, Col Fred Helms, Lt Col Stephan Gray, Lt Rick Blaize, CMS (Ret) Bob Nichols, CMS George Wood, SMS Clayton Brennan, MSG Robert Barrett, MSG James Alber, MSG Joe Forehand, MSG Robert Wortham, SRA Robbin Click, and Mr Rick Ricco, of the Air National Guard, Col Philip Engstrom, Lt Col Bob Bryan, Lt Col Woody Woodcock, Capt Bob Dickmeyer, and MSG Kathlyn Pegg of Headquarters Standard Systems Center, Capt Kevin Illsley, SMS Matthew Sanders, and Mr Rich Mauer of Air Training Command.

I wish to extend a special thanks to Col Phil Engstrom and his staff at Headquarters Standard Systems Center for their excellent cooperation and taking the time to review the CAMS information in this paper for technical accuracy.

LIST OF ABBREVIATIONS

ACM	Aircraft/Egress Configuration Management System
AFLC	Air Force Logistics Command
AFR	Air Force Regulation
AFSC	Air Force Specialty Code
AFSC	Air Force Systems Command
ANG	Air National Guard
ANGR	Air National Guard Regulation
ANGSC	Air National Guard Support Center
APDS	Automated Personnel Data System
ASM	Automated Scheduling Module
ATC	Air Training Command
ATERS	Automated Test Equipment Reporting System
C-E	Communications-Electronics.
CAI	Computer Aided (Assisted) Instruction
CAMS	Core Automated Maintenance System.
CBT	Computer Based Training.
CBPO	Consolidated Base Personnel Office.
CDC	Career Development Course.
CEMS	Comprehensive Engine Management System.
COMPES	Contingency Operational/Mobility Planning and Execution System.
CPU	Central Processing Unit.
DBMS	Data Base Management System.
DCM	Deputy Commander for Maintenance.
DETS	Deployable Engine Tracking System.

DIFM	Due In From Maintenance.
FTD	Field Training Detachment.
GLCM	Ground Launched Cruise Missile.
HQ	Headquarters.
HQ/SSC	Headquarters Standard Systems Center.
ISO	Isochronol Inspection (Military Airlift Command)
IVD	Interactive Video Disc.
IVI	Interactive Video Instruction.
JC	Job Control.
MAJCOM	Major Command
MDC	Maintenance Data Collection
MMICS	Maintenance Management Information and Control System
MOC	Maintenance Operations Center
MTT	Mobile Training Team
NGAUS	National Guard Association of the United States
NGB	National Guard Bureau
NMCS	Not Mission Capable Supply
NPS	Non Prior Service
OJT	On the Job Training
P&S	Plans and Scheduling
PAMS	PMEL Automated Management Subsystem
PCA	Permanent Change of Assignment
PCS	Permanent Change of Station
PM	Program Manager
PMEL	Precision Measurement Equipment Laboratory
PPBS	Planning Programming and Budgeting System

QA	Quality Assurance
QAP	Quality Assurance Program
QC	Quality Control
RACC	Reparable Asset Control Center
REMIS	Reliability and Maintainability Information System
RPC	Repairable Processing Center
SBSS	Standard Base Supply System
SIRS	Status Inventory Reporting System
TAC	Tactical Air Command
TASG	Tactical Air Support Group
TCTO	Time Compliance Technical Order
TFG	Tactical Fighter Group
TFW	Tactical Fighter Wing
TO	Technical Order
TPR	Training Personnel Requirement
UTA	Unit Training Assembly
UTC	Unit Type Code
349	Maintenance Data Collection Record
350	Repairable Item Processing Tag
781A	Maintenance Discrepancy and Work Document
781H	Aerospace Vehicle flight Status and Maintenance Document
781J	Aerospace Vehicle-Engine Flight Document
781K	Aerospace Vehicle Inspection, Engine Data, Calendar Item Inspection, and Delayed Discrepancy Document

INTRODUCTION

Purpose of paper

This paper is a direct result of a request by Col Warren Grant, Director of Information Systems Division, National Guard Bureau, and Col John Barnhart, DCS/Plans and Requirements, Headquarters Standard Systems Center, to analyze:

- The unique training requirements of the Air National Guard (ANG) aircraft maintenance mechanic.
- The quality and quantity of training given on the Core Automated Maintenance System (CAMS) being installed in all Air National Guard aircraft maintenance organizations.
- Alternatives to current instruction methods, if there are training shortfalls.

Why study is needed

The Air National Guard, throughout its short history, has been called on several times to bolster the United States Air Force. We must ensure it is a highly trained, efficient, and combat capable, fighting force.

The ANG as we know it today emerged right after the end of WWII. As a matter of fact, it predated the birth of the Air Force in 1947 by about a year. The first ANG unit was the 120th Fighter Squadron, activated in April 1946, located in Denver Colorado. The beginning of the Air

National Guard was a result of political planning for life after World War II.

General George C. Marshall, Army Chief of Staff, wanted a system of universal military training in the postwar period. To get the support of the powerful National Guard Association of the United States (NGAUS) he assured the National Guard Bureau (NGB) they would continue to be the Army's primary reserve force.[1]

Until the Korean War the Air National Guard was regarded by the Air Force as a flying club with little combat capability. The results of operational readiness inspections in 1949, conducted by USAF, concluded it would take an average of 86.6 days after mobilization for ANG units to be operationally ready.[2]

During the Korean War the Air Guard alone provided 45,000 airmen, almost eighty percent of its strength. Mobilization pointed out many problems. Tactical units required anywhere from three to six months of intensive post mobilization training before the Air Force considered them combat ready. They had to be, in many cases, retrained and reequipped.[3] Once done, the performance of the guard units in Korea and elsewhere in the world highlighted their capabilities.

Prior to 1960 this nation relied on a strong active military establishment to maintain national security. When those forces proved insufficient we called up the guard and reserve, gave them extensive training, and deployed them to

the war zone to augment the active forces. The atmosphere during this time period, due to the capability of weapons systems, was almost casual. We had the time to mobilize and train the reserve components.

During the 1960s other factors entered the picture. Lack of national resolve regarding Vietnam, the huge monetary costs of maintaining the conflict in Vietnam, and budget cuts suggested "business as usual" was not the proper coarse of action.

The total force policy implemented in the early 1970s was a way of accomplishing two goals. The first was to make sure the reserve components were used in any major conflict. The second, and just as important, was one of defense dollars. The planning, programming, and budgeting system (PPBS) caused the spending of defense dollars to be closely scrutinized.

As I stated earlier, reduced defense expenditure was not the only reason for the total force policy. Secretary of Defense Melvin Laird (1969 - 1973) was a member of congress during the Vietnam buildup and experienced the frustration of not calling up the reserve forces the U.S. had been training for so many years. His idea of total force was largely driven by his belief the United States should never go to war again without calling up the reserve forces. This policy so integrated the reserves with the active force that today, it is virtually impossible to perform any hostile action without using some part of the reserve forces.

With the modern day reserve forces being an integral part of the total force, it is imperative that reserve forces be prepared to participate at the earliest stages of any future conflict. A strong reserve force and national will is a strong deterrent to armed conflict. Over the last fifteen years much progress has been made in equipping and training the ANG with modern aircraft.

Today the Air National Guard provides seventy-eight percent of the air defense, fifty-four percent of tactical reconnaissance, forty percent of tactical air support, thirty-five percent of theater airlift, twenty-five percent of tactical fighters, and eighteen percent of the strategic tanker force.[4] The Air National Guard is the fifth largest air force in the world.

There are 115,000 airmen with 1700 aircraft in the ANG. Many of the ANG units are tasked to be mobilized within twenty-four hours and ready to deploy to their combat destination within seventy-two hours. In this "come as you are" scenario it is important for the traditional guardsman to be highly trained because there will no longer be the three to six month training time prior to deployment.

Core Automated Maintenance System

CAMS is a management tool. Not using this tool or not using it wisely will not decrease the combat capability of a flying unit. However, using it effectively can significantly improve the decision making process that can lead to increased combat capability. This new system is being

installed in the Air Force, Air National Guard, and Air Force Reserve aircraft maintenance organizations. It is an outgrowth of modern weapon systems such as the F-15, F-16, B-1B and B-2. Each of these weapon systems had their own system for tracking and reporting maintenance actions. CAMS standardizes the reporting and acquisition of these maintenance actions. Use of CAMS is not optional but, effective use cannot be dictated. Knowledge, gained through training, makes CAMS an effective tool.

CAMS provides an important improvement in maintenance data collection, analysis, and maintenance capability projection. One of the major features of CAMS is the automated forms processing of the following aircraft maintenance forms:

AFTO Form 349--Maintenance Data Collection Record

AFTO Form 350--Reparable Item Processing Tag

AFTO Form 781A--Maintenance Discrepancy and Work Document

AFTO Form 781H--Aerospace Vehicle flight Status and Maintenance Document

AFTO Form 781J--Aerospace Vehicle-Engine Flight Document

AFTO Form 781K--Aerospace Vehicle Inspection, Engine Data, Calendar Item Inspection, and Delayed Discrepancy Document

Installation of CAMS will be complete at all Air Force, Air National Guard, and Air Force Reserve bases by late 1991 or early 1992. The system consists of ten software increments (modules) but only about half (four +) of these increments are available to the field. The remaining incre-

ments are being developed and released to the field as they are tested. This piecemeal installation (the only feasible way of doing it) presents its own set of training challenges.

CAMS, in its present limited capability, is available at about sixty percent of the airbases. This is an expensive system, approximately $265 million life cycle cost, that will save considerable dollars.[5] In the era of shrinking defense dollars it is important we use this system effectively. CAMS is an ideal system to study; it is being developed and installed now; it can significantly improve our war fighting capability if used properly; there are some training shortfalls that need to be addressed.

Where CAMS information came from

There is little written material on CAMS other than the system documentation. I relied completely on interviews with personnel that designed, developed, installed, and used the system. They were candid in their interviews and did not hesitate to identify shortcomings but were also quick to praise the system.

Organization of the paper

This paper is separated into five chapters. Chapter I analyzes the challenge of training ANG traditional aircraft maintenance personnel. It specifically addresses the limited time available, and the unique requirements of training the "weekend warrior". The second chapter is devoted to the capabilities of CAMS. The author is interested in what the driving force is behind CAMS, what it can do, and why it is

important to our war fighting capability. Chapter III addresses the way aircraft maintenance personnel, both full time and part time, are being trained. There are unique training challenges such as, availability of the individual, funding for training, and retention of information. Chapter IV provides an alternative method to platform instruction to provide the necessary training of the traditional guardsman on CAMS. It is the use of interactive videodisc (IVD), a proven improvement in classroom type instruction environments, that is investigated. The final chapter of this paper is the conclusion and recommendation.

The future

The ANG is progressing toward new systems; guard units are upgrading to newer aircraft; their conversions are occurring at a rapid rate; they are becoming more integrated with the active duty forces. It is apparent that as technology changes in the field of education there must be a change in the way traditional aircraft maintenance personnel are trained. This change in the way personnel are trained is also applicable to the full time guardsman and probably to the active duty maintainer as well.

No one questions the training, quality, or qualifications of full time ANG aircraft maintenance personnel. Most say they are a superior trained force. It is the training of the traditional guardsman, where training technology is not keeping pace with training requirements. This paper is

directed toward training the traditional guardsman. Throughout this paper when I reference training of ANG personnel, I am referring to the traditional guardsman.

CHAPTER I

AIRCRAFT MAINTENANCE AND TRAINING

HISTORY

This nation has not experienced a major mobilization of reserve forces since World War II. The most recent mobilization, a limited one, occurred in January, 1968. The North Koreans seized the USS Pueblo, and President Johnson immediately issued Executive Order 11392 on January 25, 1968, mobilizing 9,000 air guardsmen. Within thirty-six hours over ninety-five percent of them reported to their units. They remained in place for nearly three months before deploying overseas.[1]

The Total Force Policy came into being five years later. Today, this policy places a significant portion, twenty-six percent, of the combat capability of the Air Force in the Air Guard. In many ways this policy helped the guard overcome the training problems identified with the 1968 mobilization. In other ways it contributed to and created additional training challenges. Congress places a high reliance on the air guard to perform its tasks. It is appropriate to ask if they are as well trained as they can be.

1968 MOBILIZATION

The Pueblo crisis resulted in the mobilization of eight tactical fighter units of the Air National Guard in January, 1968. Eventually (three months later) six of these units deployed overseas. In those first months no one knew

what the mobilized forces were going to do. Several factors contributed to this delay.

Organization

First, there was a dissimilar organization between the ANG and Air Force. The Air Force needed flying squadrons but did not need the maintenance or support personnel for those aircraft. The Air Guard is organized under a wing-group-squadron concept. While the organizational structure allowed selective mobilization of portions of a unit the Department of Defense elected to mobilize entire units. Eventually personnel were split up and sent where needed.[2]

Tasking

Second, guard units were not tasked by Operations Plans (OPLANS). There was no clear definition of where to deploy these mobilized units. Suddenly the Air Force was faced with trying to find a use for these activated forces. In the meantime the guard units languished at home station for three months, creating severe morale problems.

Aircraft Maintenance

When the guard units were recalled to active duty in 1968, it was a shock to the maintenance personnel because all of a sudden there were a lot of pilots available to fly aircraft. As the aircraft mechanic tightened the last nut on the airplane, there was a pilot waiting to fly it. Before mobilization, pilots worked at a civilian occupation and scheduled their flying time in advance. For example, at 4:30 on a Tuesday afternoon the unit knew how many pilots were

going to show up for night flying, how many aircraft were scheduled to fly, and what the configurations would be. The flying program was maintenance driven.[3] Again as an example, a unit would fly on Monday, stand down for maintenance Tuesday, fly Tuesday night, stand down for maintenance on Wednesday, fly Thursday, and stand down for maintenance on Friday. This cycle repeated itself week after week. After mobilization the flying program immediately became operations driven. There was always a pilot available, needing to fly.

Quality of people

Maintenance responded well for three reasons. First, the U.S. was not involved in a shooting war therefore surge capability was not important. Second, there was a well trained cadre of experienced maintenance personnel (the full time technician). Third, the non-prior service personnel joining the Guard were of high quality.

Retired Chief Master Sergeant Bob D. Nichols, a former aircraft mechanic who deployed with the 127th TFS to Kunsan, Korea in 1968, believes the guard had a higher quality work force in the 1968 era than today because of the draft.[4] Most of the people enlisting in the guard then were college students. General Bunting states:

> I personally believe and I have always felt the draft was not necessarily bad for this country. It gives you a real good pool of cheap manpower. There's nothing wrong with a guy serving for a couple of years in the active service or entering into the Guard or Reserve.[5]

When the units finally deployed overseas surprisingly it was the part-timers that came through for the guard in

almost all fields. They were younger, more energetic, not as experienced but really "gung ho". Chief Nichols observed that they felt they were over there to do a job, and were eager to get on with it. The technicians, the full time guard work force, displayed the attitude that I hope I can survive this until I get back to my home and kids.[6]

The older technicians, the ones in their fifties, who were good soldiers but had lived in air conditioned homes, drove to work in air conditioned cars and worked in air conditioned offices had a hard time adjusting. They had a lot of problems when they deployed overseas because of the heat and cold, miserable living conditions (tents), running around in overshoes or heavy parkas, standing out on slick runways, and crawling around on ice covered wings. They were good in a day to day environment but in a wartime situation, the older technicians faded fast. They worked six days a week, long hours, and were in a hostile environment. In General Bunting's opinion these fifty year old airmen didn't do very well. The young airmen really came through. They were high quality people because they had elected to get in the guard rather than get drafted.[7]

Challenges identified

The Air Guard units returned from active duty by the middle of 1969. Even if this was an unnecessary mobilization it was a good exercise of the system and pointed out several shortcomings. The following main challenges surfaced:

- Lack of state-of-the-art aircraft

- An aging maintenance force
- Better training for the traditional guardsman
- Organization of the Air Guard
- Indecision as when to deploy

The guard alone could not solve these problems. It took the total force policy to make major changes. The total force policy was not implemented to solve problems in the guard however. It was a political and a budgetary decision to get more defense "bang for the buck".

TOTAL FORCE

During the wind down of the Vietnam War the United States sought ways to reduce defense spending and still maintain the capability to fulfill national security obligations. One aspect of this was to reduce the active force and increase reliance on the guard and reserve. In 1970, Secretary of Defense Melvin Laird announced the "Total Force Concept" which emphasized consideration of the reserve forces along with the active forces in supporting national strategy. Secretary Laird stated: "...Selected Reserves will be prepared to be the initial and primary source for augmentation of the active forces in any future emergency...". In 1973, Secretary of Defense James Schlesinger added his support by stating: "Total Force is no longer a 'concept.' It is now the Total Force Policy..."

The total force was not entirely a budgetary decision. The United States had just come out of an extremely large buildup of military forces for Vietnam without calling

up the reserve forces. Congress was determined that this would not happen again. The stage was thus set to place a heavy reliance on the reserve forces for protection of the U.S. This shift in emphasis caused by the total force sent much needed money and equipment to the Air National Guard and helped them solve some of the problems identified by the 1968 mobilization.

Modernization

Modern aircraft are in the Air Guard inventory. New A-7 and A-10s along with multi-role fighters such as the F-15, and F-16 are beginning to be commonplace in the Air Guard. These new aircraft with their high technology present a whole new set of challenges for training the ANG.

Operations

Operations (aircrews) have done a very good job of training their personnel. The ANG "owns" its own ranges therefore scheduling is not a problem. They do live drops at least once a year. Properly configured aircraft has been helped significantly by computerization. It is much easier now to predict aircrew needs and furnish properly configured aircraft for those needs. The ANG spent a lot of money on high technology training aids for aircrews, such as, sound on slide presentations and interactive video instruction. Operations is moving along well in the training area. This is not the case for aircraft maintenance.

Aircraft Maintenance

No one really questions the quality of Guard maintenance. It is unsurpassed even by the civilian airline industry. I am referring to the full time aircraft maintenance force. Today the primary source of aircraft mechanics is the Air Force. However, we should not be misled into believing the traditional guardsman, the one, two, and three striper is nearly as competent as his counterpart in the active force. Table 1 shows the comparison of guard training time versus active duty training time.

Table 1

TRADITIONAL GUARDSMAN TRAINING VS ACTIVE DUTY COUNTERPART
Data summarized from
AFR 39-1, AFR 39-29, AFR 50-23, and ANGR 39-29

PROMOTION TO	PRIMARY AFSC	MINIMUM TIME IN SERVICE	*GUARDSMAN TRAINING DAYS	**ACTIVE DUTY COUNTERPART TRAINING DAYS
Amn	3 Level	6 Months	180	180
A1C	3 Level	6 Months	196	268
SrA	5 Level	24 Months	227	444
Sgt	5 Level	36 Months	258	620
SSg	5 Level	48 Months	289	796
TSg	7 Level	60 Months	321	972
MSg	7 Level	108 Months	446	1676
SMS	7 Level	156 Months	571	2380
CMS	9 Level	204 Months	696	3084

* This is not an exact figure but gives a rough idea of available training time. Formulae follows:

((Mos/Yr * WrkDay/Mo) + 15 Days AT) * Productivity
((12 * 2) + 15) * .80

** ((Wks/Yr * WrkDay/Wk) - Leave - Holidays) * Productivity
((52 * 5) 30 10) .80

According to Colonel Fred Helms, former Commander of the ANG Support Center and a retired technician, the ANG should take all the traditional guardsmen and devote whatever hours available on the weekend to teaching them. The sooner they are taught, the better off they are going to be when mobilization time comes. The big problem with this is it is much easier for the technician to do the job himself than it

is to teach the traditional guardsman to do it. Some supervisors are good trainers but as a general rule they don't take the time to train the weekender.[8]

General Bunting believes there is no way the weekender is as well trained as the full time technician. However, the ANG is manned with a full time maintenance force, highly skilled and trained, capable of supporting the peace time flying mission on a day to day basis. What the part-timers allow the ANG to do is build a surge capability in case of mobilization. The guard doesn't need a surge capability in their peacetime role. However, when the experienced mechanics are mixed with the inexperienced mechanics after mobilization there will be a lot of surge capability. Before total force policy the guard units had time to train after mobilization. Now they are expected to be ready to go upon mobilization. What gives the ANG unit the capability to go to war and help out is the high level experience of the cadre plus the surge capability of the part-timers.[9]

It is wrong to think the traditional guardsman is untrained. They are not novices because they attend the various technical schools and receive hands on training. But, many times maintenance supervisors are reluctant to turn things over to the part-timer because of time constraints. There is no way an airplane can be torn down, and then be rebuilt by part-timers, during their weekend training period, because there is not enough time. We are not ready to turn over an airplane to the traditional guardsman because he is

just not up to speed. It won't take long to get them there but, under the total force policy most ANG units are supposed to be ready to go at a moments notice and provide the surge capability necessary to prosecute the war.

It is apparent from Table 1 there is much more time available to train the active duty mechanic. Where the guard has the advantage is the strong cadre of full time mechanics to impart their knowledge to the youngster. At the staff and technical sergeant level the guard mechanic is highly proficient due to tenure in the weapon system.

Tenure is a problem in itself. According to Lt Col Stephan Gray, former Chief of Recruiting and Retention, Air National Guard Support Center (ANGSC), Andrews AFB, about forty percent of enlistments in the guard each year are non prior service (NPS) people. The ideal number is about seventy percent.[10] What this means is the guard work force is aging. While the turnover rate in the guard is not high it is however, in the wrong age group for maintaining an energetic work force. The largest area of turnover is in the first term airmen. Retention in this group, nationally, is about thirty-four percent.

Quality of people

In 1973 the draft was replaced with the volunteer system. The All-Volunteer Force presented severe recruiting difficulties and shortfalls became apparent in the Air National Guard. The mix of prior service to non-prior service people changed from 30/70 to 65/35 almost overnight. Through

the years this mix has changed very little and it is currently 60/40. An energetic force requires a large input of young people.

The educational level has dropped sharply. Prior to the All-Volunteer Force ninety-four percent of the enlistees were high school graduates, many attending college. By 1980 that had dropped to forty-two percent.[11] The ANG has taken steps to help this situation by requiring non-prior service enlistees to have a high school diploma before enlistment.

Impediments to training

The traditional guardsman has limited time available for training. Table 1 pointed out the comparison of training time available to the weekender versus his active duty counterpart. What the table did not show was the additional requirements the system places on the traditional guardsman for that limited amount of time.

Out of the time the guardsman is at drill he must take time for records checks, shots, dental checks, physicals, general military training, disaster preparedness training, commanders calls, physical fitness, etc.. There are other situations that reduce the time available for training.

An individual may be ill or have a job conflict and not be able to attend scheduled training. In this case the individual schedules a make-up drill during the week. It is unrealistic to believe the individual will get any formalized training during this make-up period. I do not mean the individual will not be gainfully employed. On the contrary he

will be fitted in with the full time work force. What does occur is he misses out on any formal training that was scheduled during the regular Unit Training Assembly (UTA). Training offered during the week such as that offered by a Field Training Detachment (FTD) is usually unavailable to the traditional guardsman due to his civilian job requirements.

Training offered by Air Training Command (ATC) that is over two weeks in length is virtually impossible for the traditional guardsman to attend because of his civilian occupation.

ATC training that is offered in short courses, two weeks or less, may not be offered at the time the individual can attend. Training slots at ATC are limited. With the budget cuts we are experiencing and will continue to feel in the future, TDY training funds are going to be limited.

SUMMARY

The mission of the ANG has been and will continue to be the training of a fully combat capable force for the Air Force. The Total Force Policy I referenced earlier states "...Selected Reserves will be prepared to be the initial and primary source for augmentation of the active forces in any future emergency...". This means the national security of the U.S. requires the guard to be fully trained. It places a tremendous reliance on the traditional guardsman to robust the force and provide the surge capability that will be needed in time of mobilization.

There are severe challenges to accomplish that train-

ing. I have identified them in previous parts of this paper and they are summarized as follows:

The guard's full time work force will continue to age. I doubt seriously, without the draft, if we ever see the NFS personnel exceed the forty percent level. Therefore, a heavy reliance will continue to be placed on the younger traditional guardsman to carry the brunt of the work load in event of mobilization.

Twenty years ago, prior to the All-Volunteer Force, the educational level was much higher. The ANG was highly selective because there were well educated young men standing in line to join the guard. Practically all had high school diplomas and a large number were attending college. We are a high tech society and so are our weapon systems. We need better educated personnel or an ability to provide better training for the people we are getting.

The weapon systems in the guard are being modernized which equates to higher complexity. Additionally, the guard is converting to different weapon systems faster than ever before. The training problems associated with these conversions will not get better because for total force to continue to be successful conversions must be an ongoing process. The Air Force and ANG cannot afford to continue to maintain dissimilar weapons systems as in the past.

The training time available to the guardsman is very limited with myriad demands on it. These demands do not decrease but, as history dictates, they increase.

Retention of training received is difficult. It is very hard to stay proficient or remember tasks that are only performed once or twice during a thirty day time period. That is the time between UTA's.

Availability of ATC schools is limited due to the length of school, time of school, and/or availability of a slot.

FTDs, normally, are not available to the part-timer.

Training provided at times other than the normal UTA's is generally not effective. The resources are not available to provide the training and so far we have not been able to provide individualized training.

Job conflict is probably one of the biggest problems contributing to lack of training. In peace time we must remember the traditional guardsman is a civilian first and a guardsman second. His first loyalty must be to his civilian employer. Upon mobilization, he becomes a USAF asset and his loyalty shifts. This dual loyalty is not a problem as long as we provide him the training he needs, when he needs it, and before he is mobilized.

CHAPTER II

CORE AUTOMATED MAINTENANCE SYSTEM

> Standard base-level maintenance management system for aircraft, Ground Launched Cruise Missiles, Engines, Trainers/Simulators, Support and Test equipment, Some Munitions, and Communications-Electronics Systems.
> -- Core Automated Maintenance Systems (CAMS)

BACKGROUND

The information in this chapter came from the author's interviews with the professionals who developed CAMS at Headquarters, Standard Systems Center, located at Gunter AFB, Al. Since there is little written information on CAMS the author relied totally on their expertise in the aircraft maintenance field and knowledge of CAMS. Where possible, the author identifies specific information attributed to an individual by reference to name and footnote. In most instances there is no specific reference because the information was duplicated by several individuals during interviews, conversations, and telephone questioning. This entire chapter has been reviewed by these dedicated professionals and the author extends his most sincere appreciation to Col Phil Engstrom[1], Lt Col Bob Bryan[2], and Capt Bob Dickmeyer[3].

Why CAMS was developed

CAMS was developed to provide an automated information system for base-level maintenance managers. The newer weapons systems have all grown into the world of automated data processing (ADP) for maintenance management information. As each new weapon system came on line it had its own unique

ADP system. The F-16 has its unique system. The B-1B came on line with its unique system. Without CAMS the B-2 would have its unique system. In most instances these ADP systems do basically the same things with a few minor variations. This redundancy causes the development dollars, the maintenance dollars, and the software program dollars to be duplicated in each system program office. The Air Force wanted to standardize these ADP systems so, at a very minimum, they would gain a dollar savings by doing away with redundancy. The Air Force wanted one standard ADP system for aircraft maintenance.

CAMS versus previous systems

CAMS doesn't necessarily provide any different or any more information than for example, the F-16 Central Data System provides for F-16 users. What is different is it provides standardized information to all users be it F-16, F-4, A-10, C-141, B-1, B-52, etc.. For example, it provides real time information on aircraft configuration status, and scheduling requirements for the various maintenance schedules that have to be met. Additionally it provides production schedules for reparable assets, where they are in the cycle, whether on or off base. It has automated history retrieval. Much of this information existed in previous systems. However, CAMS puts it all together into one standardized system. Once CAMS is fully developed, there will be a tremendous cost savings. In its final implementation it can increase combat capability because, whatever information the Deputy Commander for

Maintenance (DCM) is looking for, it is provided.

Cost of CAMS

The CAMS life cycle costs are in excess of 265 million dollars. The host base computer (UNISYS 1100 System) specifications were developed with CAMS in mind. CAMS will utilize up to eighty five percent of the host base computer system's capacity. The cost of any 1100 System upgrades resulting from CAMS implementation is borne by the CAMS project. The life cycle costs do include the remote terminals in maintenance but not the training costs incurred by Air Training Command (ATC).[4]

CURRENT CAPABILITIES

Maintenance Data Collection (MDC) Subsystem

This increment automates the MDC process. Instead of manually filling out the 349, a facsimile is generated on the computer, in the work center, in real time. It eliminates the need for someone in keypunch to enter the data. It eliminates errors because of the on line edits. Accuracy of data is significantly improved. In the older systems, such as Maintenance Management Information and Control System (MMICS), if there were errors they were returned and the shop supervisor or branch supervisor had to review the 349. This is very time consuming. In the CAMS, 349 information does not get lost because it is stored in the CAMS data base. Of course when the MDC data is entered the historical, TCTO, time change, and inspection records data base is also updated. Additionally, equipment status is also updated

Status and Inventory Subsystem

This system allows you to load all of the equipment into the CAMS data base whether it is support equipment, or the aircraft itself. Additionally, during the initial inventory loading the desired rates for partially mission capable maintenance (PMCM) and not mission capable maintenance (NMCM) can be input. This provides the capability to do an analysis of the data base so that at the end of the month mission capable (MC) rates can be determined. While this information is valuable locally it is used quite extensively at the MAJCOM.

Training/Personnel Subsystem

All data regarding maintenance personnel is loaded into this data base. It will produce the traditional manning roster by shop, by work center. CAMS provides for all the training courses to be entered so it can link the people and the training courses together. For example, if an airman is assigned to the Nav Shop and the Nav Shop has a number of prerequisite training courses they are automatically loaded against that individual so he/she can be tracked to make sure all the essential training is completed. CAMS also provides training forecasts. If for example, an airman is coming due for some type of training in ninety days, the system will alert the supervisor. This type of data base was available in MMICS. CAMS automated the bookkeeping process.

Comprehensive Engine Management System (CEMS)

This is not the CEMS used by the Air Force Logistics Command (AFLC). It is a CAMS-unique system. Essentially, it is similar to the status and Inventory Subsystem in that initially all engine and engine accessories are loaded into the CAMS data base. Engines are tracked as separate entities. This subsystem was built to facilitate the retrieval of status and configuration information. It also forecasts time change requirements. The information gathered on engines is very similar to that collected on the aircraft, only it's CEMS unique. One important aspect of this system is, it automatically upchannels reports on the status and configuration requirements to AFLC.

Inspection/Time Change

This system allows tracking of such things as engine inspections, time changes, etc.. These are the kinds of critical items that can cause an organization to go "overdue inspection" because of lack of follow up. The MDC system updates this system. Most of the subsystems in CAMS are interrelated. One of the prime functions of CAMS is to allow for the establishment of job standard tables or job flow packages. An isochronol inspection (ISO) has a job standard number and when it is coming due it is only necessary to enter that job standard number and CAMS will sequence all the actions necessary to complete that ISO. CAMS can track by inspection date so maintenance will know when inspections are coming due.

Time Compliance Time Change (TCTO)

TCTOs are entered into the CAMS data base which provides the ability to track the changes. It significantly reduces the possibility of overlooking a TCTO. All necessary actions required to complete the TCTO can be established and documented similar to an inspection.

PMEL Automated Management Subsystem (PAMS)

PAMS automates the PMEL function by automating the production control process through the use of LOGMARS (bar code) technology. A part with a bar code label will come in for calibration, a bar code scanner will read the part number, identify the part, and any corresponding inspection requirements. The lab will know everything that needs to be done on that part, along with the technical order (T.O.) requirements. All the information they need for that part is built into the system. When a new part is introduced to the system, it is assigned a unique bar code label and the T.O. inspection requirements are linked to it.

MAJCOM Unique Systems

Several MAJCOM unique systems are supported by CAMS. For example, the B-1B aircraft required a unique interface so that all B-1B bases could be linked together. With a system called Configuration Status & Accounting System (CSAS) all B-1B bases are linked together. The B-1Bs are the only bases that use this subsystem. Another system was developed specifically for the Ground Launched Cruise Missile (GLCM) bases. Their needs are a little different than aircraft.

Automated 781 Forms

The aircraft 781 forms are automated. Specifically, the 781As (Maintenance Discrepancy Document), the 781Js (Aircraft and Engine Operating Times), and the 781Ks (Aircraft Inspection Status, Engine Data, and Delayed Discrepancy) are all computer generated. These automated forms are easy to transcribe, save time, are more legible, and improve accuracy.

Automated Debriefing

While this system has not been released worldwide it has been fully developed, tested, reviewed and installed at several test bases. It will be released in the spring of 1989. Essentially, it automates the debriefing process. After a flight the pilots will debrief the aircraft to the crew chief who will have a screen in front of him, and capture all the discrepancies. This procedure will automatically generate the work orders (349) and send them to the shop and job control simultaneously. Obviously this reduces the time and paper work associated with a manual 349. One important feature it can perform is when a work unit code is entered, the debriefing subsystem can scan the CAMS data base and look for all discrepancies against that aircraft for that same work unit code and identify if it is a possible repeat discrepancy. It also produces about sixteen analytical reports. In the past, maintenance analysts had to prepare these reports, such as "mean time between failure", manually. The computer produces them much faster and more accurately.

Automated Scheduling Module (ASM)

Automated Scheduling is the only micro-computer application currently available. It runs on a Zenith Z-248 and automates the plans and scheduling function. By doing so it eliminates the need for manual grease boards and the number crunching that used to take 12-14 hours to generate a flying schedule. It not only generates a flying schedule but also the maintenance schedule. This subsystem checks inspection requirements versus the flying schedule and produces a de-conflicted flying schedule. This feature allows maintenance to do long range fleet projection and availability because they know the firm maintenance requirements and can input the flying requirements.

Basically, pertinent records in the mainframe data base, (time change, dates, operating times, and recurring inspections information), are downloaded to the micro. This data is then manipulated independent of the host computer. Because it is micro-computer based, it is deployable. This module can be used in this same manner at the deployed location. Another benefit of the micro-based technology is the independence from the mainframe. When the mainframe goes down, and they do go down for either scheduled or unscheduled maintenance, plans and scheduling can still work the ASM.

Automated Test Equipment Reporting System (ATERS)

ATERS provides on-line access to a data base containing the various pieces of test equipment in the avionics shop. Avionics personnel will be able to add and delete test

equipment, update information about the equipment, display status, show utilization, and shop backlog. Additionally, the system will track maintenance actions on the test equipment. Use of this system will allow establishment of job standards and aid in scheduling/re-scheduling of events.[5]

Aircraft/Egress Configuration Management (ACM)

The ACM system will provide both on-line and off-line input of information to update the equipment and configuration records in the data base. Users will be able to add and delete assigned equipment and in the on-line mode update the configuration records in real-time. This system is not mandatory and its use will be defined by the MAJCOMs.[6]

CURRENT DEVELOPMENT

Interfacing CAMS with Supply (CAMS/SBSS)

With the CAMS/Supply interface, the maintainer who needs to order a part, will be able to enter that order directly into the supply system from his terminal. In addition, with on line inquiry, maintenance will know immediately if the part is available. Job control can make a management decision, based on whether or not it is in supply or bench stock, to cannibalize the part from another source. As soon as the mobile terminals are available the parts ordering will move out to the flight line, right at the aircraft. This interface removes all the hassles of paper work associated with parts ordering.

Follow on to CAMS/CEMS Interface

The current increment in CAMS is not on line to the CEMS data base at the AFLC. Therefore, the data is gathered at base level through CAMS and then sent off line to the central data base at the AFLC. It takes up to a week to put the data on tape and get it into the CEMS data base. This modification will allow CAMS to directly communicate to CEMS. It will be significantly faster which means the re-supply pipeline will be filled much quicker. It will help the CEMS people and the maintainers because they will get the part back much faster. On line edits are being added which will improve accuracy and also improve the overall response of the system.

Additional interfacing with the CEMS Engine Trending and Diagnostics System is being implemented. Soap samples, engine cycles, etc., will be entered and the system will provide the condition of the various engines. Currently this is an independent terminal setup in the engine shop. The new interface will make it much easier because there will be only one terminal to maintain for the shop.

CAMS is being interfaced with the Deployable Engine Tracking System (DETS). When aircraft are deployed maintenance needs to know the condition of their aircraft. Maintenance will be able to download all the essential engine information before deploying. They will have all the parts tracking and information of the aircraft engines and will be able to keep it updated. When they return from deployment

they will be able to update the host computer thus keeping the information current. This will satisfy some of the deployable requirements of the MAJCOMs.

Automatic Scheduling Module -- Phase II

Phase II will enhance the interface with the mainframe. Once the maintenance schedule is developed and approved it will be sent back to the mainframe, which will automatically generate the corresponding work orders. Currently they are manually generated. Now, the computer will do this and save quite a bit of time. The system will allow the user to print schedules and output products in user defined formats. Each command likes their data in a slightly different format. Capability projection and long range projection are all part of the package. The ability to track maintenance plan effectiveness, and maintenance scheduling effectiveness is built into the system. In the past it has been a long manual process to determine maintenance scheduling effectiveness.

Enhancement to the Status and Inventory Reporting System

This enhancement may be micro-computer based. Essentially, it will automate the Job Control/Maintenance Operation Center by automating the weapon system controller board. Instead of having the grease boards showing tail number, location, fuel load, scheduled to fly, etc., all of this information will be in the computer. Maintenance will be able to track everything from the computer. This feature will allow Job Control to have the same information from the data

base as everyone else. Job Control will not be writing information on the grease board that is not in the data base. If the Status and Inventory Reporting System (SIRS) is micro-based it will possibly satisfy one of the CAMS deployability requirements.

Automate the Personnel Availability System

This enhancement will automate the Personal Availability System (PAS). Plans and scheduling primarily does it using a manual process whereby, each morning, specialist work centers provide Job Control with their specialist forecast. Job Control then develops the scheduled and unscheduled maintenance requirements. By automating the forms associated with PAS, personnel available forecast, maintenance pre-planning, and shop workload, the system will automatically be automated. This enhancement will automate the specialist dispatch control log. It will still be a manual log and it will still have to be transcribed but it will be more accurate because it has a common data base.

Automate part of Quality Control/Assurance (QA)

By automating the inspections, calculations, end of the month reporting, etc., QA will be able to do computerized trend analysis. They will be able to provide summaries, and output products that will give the shop supervisor more information about the quality of his people. For example, they can give a work center an alphabetized roster and show that "Airman Smith" failed three of his last fourteen inspections, but the failed inspections are all on the same piece

of equipment. Maybe the shop supervisor needs to look at training requirements. QA has a requirement to keep the DCM apprised of the condition of his aircraft and equipment, but they can also help out the maintenance managers in knowing where problems exist. This enhancement also automates the weight & balance program and the functional check flight program.

Provide a REMIS/CAMS Interface

Reliability & Maintainability Information System (REMIS) is an AFLC central data base and the maintenance of it is their responsibility. This enhancement will provide an interface between REMIS and CAMS so that the CAMS unit will update the information the system managers and item managers need to manage their fleet. There are so many parts on today's aircraft that have to be tracked, that only a computer system will allow it to be done. One aspect of this increment is to allow the AFLC to identify, by aircraft tail number, what the authorized part numbers are and what the authorized work unit codes are. This ensures a particular aircraft has only authorized parts because in CAMS the assumption is that if it is on the airplane it is authorized.

FUTURE DEVELOPMENT

Interfacing with Consolidated Base Personnel Office (CBPO)

Currently, all the personnel records of the maintenance personnel including their position number, man number, Air Force Specialty Code (AFSC), are entered in the training subsystem. When CBPO prints out a roster, and CAMS prints out

its maintenance management listing, the two listings will not agree. The problem is the CAMS data base does not have the same information as the CBPO data base because of updates made to the CBPO data base that don't get entered in CAMS. There is no interface between them. With this new software release an interface between CAMS and APDS (CBPO's data base) will be developed. CBPO's data base will be read and CAMS data base reconciled to it so that CAMS will parallel CBPO. That way both data bases agree. That also means, if a permanent change of station (PCS) action, or a permanent change of assignment (PCA) action occurs, it will automatically be loaded into CAMS because of this interface. Any update to the CBPO data base will automatically be reflected in the CAMS data base. Currently, to change a position number in CAMS, it takes ten different transactions and about fifteen minutes. It's complex; it's cumbersome.

Production Scheduling

Essentially this will automate the Reparable Processing Center (RPC) by building a data base that can track Due In From Maintenance (DIFM) items. Maintenance will know the online status, location requirements, where the part is, and the condition of the part. When a part goes into repair cycle and the RPC schedules it out to a shop the RPC will be able to track it through the system. CAMS will be able to build inventory for all the assets entering the repair cycle.

Interface to Contingency Operation Mobility Planning Execution System (COMPES)

COMPES is a mobility system and has all the packing lists and all the information needed to support the Unit Type Code (UTC). Currently, CAMS is not interfaced with COMPES and the programs/mobility folks have to manually update COMPES. An interface to CAMS is going to be built so the programs/mobility people automatically will be able to produce a logistics material list peculiar to maintenance. For example, a load list, or a packing list, or anything that has to do with mobility can be produced. As much as fifty percent of the items on a deployment belong to maintenance.

Additional Deployable Requirements

The MAJCOMs are still working on a definition of what the deployable requirements are. They have identified a need for audit, automated scheduling, deployable debriefing, and deployable engine management. Of all areas in CAMS, this one is the least defined. If there is a slip in the CAMS final implementation date it will probably be caused by the deployable requirements.

FINAL IMPLEMENTATION

If the schedules do not slip, all bases including the Air National Guard and the Air Force Reserve, along with all increments of software, will be installed by late 1991 to very early 1992. All software increments as they are currently defined will be developed, tested, and fielded by November 1991. This is predicated on no schedule slips. If

there is a major data base change the schedule can slip but, not more than a very few months.

SUMMARY

Aircraft maintenance organizations will not have the option of using CAMS. Currently there is an ideal level, an acceptable level, and many levels in between, of CAMS usage. Until all areas in the maintenance community are under CAMS, and that won't happen until late 1991, maintenance can do a lot of their work outside of CAMS. They can after the fact, update history and things like that but, that is not using CAMS as it was designed. That is just another way of doing maintenance data collection, after the fact.

CAMS is a management tool. It provides information to aid the manager or supervisor in making better and quicker decisions. CAMS can produce an ideal schedule of the best aircraft to take on deployment. However, there may be some information that isn't loaded into the system or there may be some reason why a commander needs to vary that information. If a manager decides to let CAMS be the driver for production rather than using CAMS as a management tool to give him information, that decision may impact his ability to deliver. If CAMS is viewed as taking away the people side of the decision process, that is a mistake.

CAMS automatically provides the data a shop chief needs to make decisions. It saves that shop chief a tremendous amount of time gathering data. It will help them make their decisions and will give them more validation for the

decision they make. It is still up to the shop chief to make the decision and that shop chief must have the ability "to do his own thing". CAMS is not meant to change the way a maintenance organization runs.

When the CAMS data base is loaded with all of the items needed to develop a maintenance schedule it is practically limitless as to the schedules it can develop. The CAMS data base contains the aircraft tail numbers, components, support equipment, personnel and their skill level, time change items, etc.. For example, a schedule based on when the next periodic inspection, either by aircraft hours or time hours, can be produced because each time the aircraft flies the data base automatically is updated. It is only a matter of requesting the particular schedule required. Schedules can be produced to predict future requirements such as how many hours or flights until a particular maintenance function is due.

A schedule of tail numbers based on all the aircraft available to fly can be produced. It can predict when the next aircraft wash is due, when periodic maintenance is due, when component changes are necessary, and when time change items are due. All of this can be built into the schedule and the system can do this in anywhere from thirty minutes to four hours. These functions take schedulers two solid days using a manual system.

When the production scheduling subsystem is developed it will interface with the Status Inventory Reporting System

to provide an automated process to "real time" track the status of, and what needs to be happening to, each of the major components or pieces of equipment.

This will automate the base level reparable processing center function and it will show where a reparable item is in the system. It can give the shop chief the priority of what needs to be done but, the shop chief still manages his workload. CAMS can get the shop chief in trouble if he lets it drive his shop all the time. Ultimately, it may not drive the shop the best way. CAMS is only a management tool.

Software increments are being developed to establish an active interface between CAMS and the standard base supply system. It will automate the parts ordering process, provide online status reporting and in work status at base level. Currently, in the maintenance work centers someone is tied to the supply computer. CAMS does away with the side by side computers.

Authorization to clear "red x" items is much more controlled. The system will only respond to the correct authorization code. Personnel records are built into CAMS so there will be a direct tie to the personnel data base, and all maintenance personnel records will be in CAMS along with all their formal training. Additionally, maintenance can update the data base with any maintenance-unique local training. This would include the ability to sign off "red x" items. When an individual attempts to sign off a "red x" the system will validate his code against CAMS. If he is author-

ized to clear a "red x" then it will allow him to do so.

Part of the CAMS Program Management Directive includes a deployable capability of some of the CAMS increments, but not necessarily all of them. It most certainly will include work order generation, historical data recovery, scheduling functions, and the debriefing function. This is scheduled to be available as part of the total CAMS package due out in late 1991. If there are problems developing the deployable concept, or the functional descriptions change drastically, there could be an adjustment in the implementation schedule to satisfy the deployable requirements. Some major air commands have differences in philosophy about deployable CAMS. Some want only the functions shown above while others want all functions. Either scenario can be done but, it will have to be worked out.

Deployable CAMS may require a higher degree of technology. If the deployable system has to transmit real time data back to the host base then some kind of data link will have to be established such as satellite communications. If the plan is to deploy and do certain functions in a data base, store that data on some magnetic medium, return home and update the host data base, it is not necessary to have high tech satellite communications. The decision on which way to go has not been made.

When CAMS is fully implemented it will be used during wartime the same as in peacetime. Data bases will be deployed along with some basis of collecting data, and a few

terminals to do the process. It will be a part of the deployment package. A unit will be able to take the historical data of the aircraft with them. They will be able to input their daily data at the deployed site and then have that data fed back to the host base. That way when the hostility winds down and they return home, they won't have the nightmare that has typically been the case, of bringing a unit back from combat.

Today, on a real time basis CAMS can be bypassed; ultimately that will not be possible. Everything is automated and if entries are not made data will not be available and that will be readily apparent. According to Col Phil Engstrom, CAMS Program Manager, in the current manual environment it is possible to close out a 349 incorrectly. For example, there could be a 349 regarding an engine problem and that 349 closed out by means of a canopy change. This will not be possible in CAMS because the system is automated on a concept of "cause and a closeout for that cause". In other words you can no longer have an air conditioning problem that is fixed with an engine because the cause and closeout for cause does not match a certain predefined spectrum of data.[7]

CHAPTER III

TRAINING AND ITS SHORTFALLS

BACKGROUND

This chapter addresses the way training is done from three different perspectives. First, I will identify what the developer, Headquarters Standard Systems Center (HQ/SSC), designed as training requirements and how they perceive it is being done. The reader must understand that HQ/SSC has no training task, nor are they manned to provide any training. As the developer however, they have a vested interest. Second, I will identify what the trainers, Air Training Command (ATC), are doing. Third, I will relate what the users, data base managers, say they are getting. Except for the summary, all information in this chapter is presented from personal interviews by the author with the individuals noted.

HEADQUARTERS STANDARD SYSTEMS CENTER'S PERSPECTIVE

Col Philip Engstrom, Program Manager, CAMS

The amount of training given or required has a lot to do with the philosophy of the maintenance organization. If the philosophy is to implement CAMS, make it work, get the right supervision to help, use OJT, and make sure the people in the data base management shops are well trained, then CAMS will be an outstanding success. If this is the philosophy, then it will take a significant amount of training at the data base manager level. It does not require much training at the data collection level. On the other hand, if the philos-

ophy is, use the system if you want to but you don't have to, then no amount of training will help that situation.

If an individual can make an entry in an aircraft form, a 781, or if he can generate a 349 himself, he can generate them in CAMS. If a DCM has personnel untrained in CAMS, make autonomous inputs to the CAMS data base, then he should have someone trained in CAMS there to help. The DCM, or a maintenance supervisor in one of his squadrons, is supposed to make sure there are no unsupervised people working who are not able to use the tools available to them, whatever those tools are.

As new releases to the system are made the MAJCOM will make the decision to send/not send a training team to an installation. The whole concept of CAMS implementation is through MAJCOM training teams. The development people at HQ/SSC work hand in hand with the MAJCOM teams to ensure they understand the change. When an increment is ready for general release it has been tested at Gunter AFB and at selected beta test bases around the country. Documentation is sent out to the using organizations, and depending on what is involved in a change, there may or may not be a training team sent out. It may be just a documentation change that is needed.

In most instances what is being released is a result of requests from the MAJCOM team. The functional descriptions and all changes are agreed upon by the MAJCOM and HQ/SSC. Many times MAJCOM teams come to Gunter to work on the various increments before release. Everything is worked together.

There is a strong formal and informal information flow process between HQ/SSC and the MAJCOMs.

There are bases where CAMS is enthusiastically accepted, right down to the flightline mechanic. They understand what they are doing, and why they are doing it, and that has to do with the philosophy of the DCM. There are other bases where the same level of people are antagonistic to CAMS. Many of the problems reported to the Program Management Office at Gunter AFB, are due to lack of training in the system. In most cases they are not problems but a failure to look at a tech manual or not knowing a tech manual exists.

There is no doubt there is a shortfall in training. The feedback has been both good and bad, and it depends on where the feedback is coming from. Those individuals who are data base managers, know their job to start with, are used to automated systems, and are being converted to CAMS, like what they're getting. The people who are having to learn it for the first time, or who are unfamiliar with automated data processing and are not enthusiastic towards it, are antagonistic. After the system is completely installed in late 1991 most of the people coming from tech schools will be trained. Additionally, the majority of people will have worked at an installation using the system and it is just a matter of re-familiarization.

ATC has been in the training game since day one. The training done at Chanute AFB is for the data base manager, and maintenance staff analysts, while the training at Shep-

pard AFB is for the crew chief. Ultimately they will be tied together.

Additionally, ATC provides a Mobile Training Team (MTT) at each base in advance of CAMS implementation. The idea behind the MTT is to train twenty-five percent of the maintenance force and then have that cadre train the rest of the maintainers.

Twice a year a formal training planning team meets to address the shortfalls of training. To date the focus of training is for the people using the data.[1]

MSG Kathlyn Pegg, CAMS Functional Analyst

There are three methods of getting training. The first is through the Mobile Training Team from Chanute AFB. The second is through the Field Training Detachment (FTD) at the host base. The third is a Computer Aided Instruction (CAI) course developed by ATC at Keesler AFB. Approximately ninety days prior to CAMS conversion date the Chanute MTT comes to the base and sets up classes to teach approximately twenty-five percent of the base's maintenance personnel. They teach three courses. One is for maintenance supervisors, another is for MDC, and the last one is for the communications/electronics personnel.

HQ/SSC expects the twenty-five percent trained by the MTT to return to their unit and train the remaining seventy-five percent of the maintainers. There is a training data base for their work center that they have access to. They can input the same transaction they learned in class and teach

their fellow workers.

Once they are converted to CAMS there are FTD classes for continuing training. Currently the FTD training is directed towards the MDC portion of CAMS. However, CAMS training is not available at all FTDs. Only the bases having CAMS installed and having an FTD will be able to teach CAMS. The MAJCOMs have requested the FTD to provide additional training. This is in the planning stage. There is also some resident training at Chanute AFB for the data base manager.

The CAI course is available from each MAJCOM and runs on a Zenith Z-248 micro computer. It teaches the same information as the MTT.[2]

AIR TRAINING COMMAND'S PERSPECTIVE

Capt Kevin Illsley, Training Staff Officer, HQ ATC

In the interview with Capt Illsley he was not aware of any training being offered by the MAJCOMs. All CAMS training is being conducted by ATC. They currently have three different courses taught thru an MTT. Actually it is the same course aimed at a different audiences. One is an executive level course for supervisors, one for communications/electronics, and one is for MDC. The philosophy for CAMS implementation is to go to the base ninety days prior to conversion and train approximately twenty-five percent of the work force that will be using CAMS. The remaining seventy-five percent will get training from the initial cadre. This concept of training, worked out with HQ/SSC, has existed for the past two years and will continue until 1991.

CAMS training will be included in the maintenance courses taught by ATC as applicable. There are many technical training courses, for the various maintenance AFSCs, that eventually will be CAMS oriented. Currently there is very limited training in the initial courses, generally at the three skill level. CAMS training is now being added to the Career Development Courses (CDC).

ATC has an aggressive Train Personnel Requirement (TPR) for CAMS MTT alone. Thru 1990 they are training in excess of 12,000 students per year. The courses are very short, two, three, and four days. The intention is to train the twenty-five percent in the ninety day period. To do that at large bases they send in additional instructors.

Scheduling is a real problem. If a base is scheduled for conversion to CAMS and they say they are not ready that really creates problems. Basically, a base must take the training when it is scheduled.

Tactical Air Command (TAC) raised a concern about the need for follow-on training. TAC is referring to training after the MTT leaves the base. Initially it was felt that if ATC trained twenty-five percent of the work force and the host organization trained the remainder then no additional training would be needed. But now after the MTT leaves the base they are finding there is a lot of personnel turnover and they need additional training. The FTD is working on a course to do that.*

Mr. Rich Mauer, CAMS Training Manager, MTT, Chanute AFB

ATC's charter, established in 1985 with HQ/SSC, set the training up so that only twenty-five percent of the aircraft maintenance people from a base would attend. Those twenty-five percent would return to their respective shops and train the remainder of their people through on the job training (OJT). Feedback on the success of this method has been good.

The MTT offers three courses. The first course, C4AST39150007 (four days), is directed to the "worker bee" level. It is for those maintainers that do the loading of data from the maintenance they conducted. The material covered only deals with the 781 aircraft forms, 349 flightline work orders, and 350s for in shop repair. This course assumes the student has never seen a computer. They are introduced to a keyboard, monitor, central processing unit (CPU), where data comes from, how to interact with it, how to input data, and how to extract data. This course does not deal with production control, maintenance scheduling or maintenance analysis people.

The second course, C4AST39150008 (two days), is an executive level course oriented towards the DCM and his supervisory staff. It shows what products are available, how to use them, where and when to use them, and why to use them. It is for those people that don't need to know all the interactions but do need to know what products are available and how they can be used.

The third course, C4AST39150009 (three days), that is for the communication/electronics people. This course teaches strictly those products that the communications/electronics people use. There is absolutely no other applicability.

There is a problem getting the people trained in ninety days. A large base may have well in excess of 1250 people that need training. In a ninety day period, with no holidays, there are only sixty academic days. Scheduling is critical.

Additionally, there is a resident course, C3AZR39150001 (twenty academic days), not taught by the MTT, conducted at Chanute AFB. This course is for data base managers and is offered several times a year. When CAMS training first started there was a big demand for this course. Lately the number of students has dropped off.

Once all bases are up on CAMS the requirement for MTT will go away. The last base to be trained, Wright Patterson (March 1991), will be the last time the MTT will be sent out. After that, training will done by OJT. Some follow-on training may be picked up by an FTD. Currently not all FTDs provide CAMS training.[4]

SMS Matthew Sanders, 3785 Field Training Wing, Sheppard AFB.

Maintenance Data Collection is the only course being taught at the FTDs. It is a thirty hour course, spread over five days, and has been taught in some form for the last two years. The MAJCOMs have now decided what they want in the FTD

course and it will be validated in March 1989. It is called a general course because it applies across a broad spectrum of career fields.

It doesn't make any difference what particular section the people are in as long as they do MDC. The intention of the FTD course is to start out where the MTT or OJT left off. There should be no need to go through any long elaborate training.

While SMS Sanders has not worked 'hands on' with the CAMS system he has had some feedback on the training. Some bases seem to work quite well. The only training they need is in the MDC area. While another base doesn't seem to work well at all. He doesn't know whether the OJT isn't working or whether they trained the wrong twenty-five percent.

The theory is, once an individual has initial training on CAMS, that individual can absorb the rest of CAMS through a self-qualification or an OJT process. However, all of the MAJCOMs have indicated a need for follow-on training. Nothing has been decided as to what should be taught. There is a possibility of different courses in the future and these may be a supplement to the Chanute MTT after it phases out in 1991.■

CUSTOMERS EVALUATION

MSG Robert Barrett, Data Base Manager, 184 TFG, ANG

The 184th converted to CAMS about a year ago and received training about a year and a half ago. The training program from the Air Force was to train twenty-five percent of the work force in formal MTT courses and those twenty-five percent were to come back to the work center and pass the information on through OJT. The problem with that whole program was that the initial training was inadequate.

The course curriculum was 'helter skelter', jumped around, and didn't have much substance to it. Only a few areas were covered. One factor contributing to the problem was the quality of the Chanute instructors. They didn't have enough analysis type people who were well versed in maintenance documentation. They didn't have enough instructors. It seemed they tasked any instructor that was available and taught the class curriculum right out of the lesson guide without any previous experience. The whole initial program was a mess.

The unit was able to train everyone they requested a training slot for. However, there were few, if any, traditional guardsmen involved in the cadre training. There are significant problems in training the traditional guardsman such as his/her availability, mandays, annual field training commitment, and day/night shift assignments.

Some of the work centers such as, Organizational Maintenance Branch (OMB), Weapons Release, Weapons Load,

etc., have developed training packages and incorporated them in their routine training plans. This training is difficult to accomplish given flying schedules and the limited time available to train the traditional guardsman.

The FTD at McConnell, the host base, is not used. About a year ago, the unit sent a representative to Chanute to work on a re-write of the field training curriculum to focus on some of the CAMS training problems. The course has been re-written and sent back out into the Field. However, the new course is not yet available at McConnell. Additionally, the bomb wing at McConnell has just finished conversion to the B1-B and they have had a large number of people to train. FTD training slots have not been available to the Guard.[6]

MSG James Alber, Data Base Manager, 190 AREFG, ANG

The 190th is hosted by McConnell AFB, and is located about 135 miles away. They converted to Cams in November 1987. They have not had any formal training. Everything learned has been from the hands on environment. They definitely need help and are trying to send an individual to Chanute later this summer. They have found there are some functions that cannot be performed without training.

There are a lot of commands they can't use because they don't know how they function. Some of the commands and functions are very well laid out and easy to understand. But to go in and do anything more than the bare basics, they are at a total loss.

The weekend personnel are not trained. They have no real background in CAMS because when they went to school, the tech schools were not teaching CAMS.

In spite of the lack of training the shops are getting quite a bit of use out of CAMS. They use strictly online, routine functions. However, they don't need anything other than what CAMS provides them. Every shop uses it to plan their schedules and workload. They have found it to be an excellent management tool.[7]

MSG Joe Forehand, Data Base Manager, 187 TFG, ANG

The 187th located at Dannelly Field, Montgomery Al, is hosted at Gunter AFB which is just a few miles away. Their Data base was converted to CAMS is January 1988 but they didn't have communications cables until June 1988. They were also faced with an aircraft conversions at the same time. The training for CAMS was provided by the MTT in July 1987. By the time they became operational on CAMS they had forgotten most of the things they were trained on.

They sent about ten to twelve percent of their full time work force to the MTT training. Very few of the traditional guardsmen have received any training on CAMS. They are a typical Guard unit in that about sixty percent of their authorized strength is made up of traditional guardsmen.

The 187th has not utilized any FTD training.[8]

SMS Clayton Brennan, Data Base Manager, 119 FIG, ANG

The 119th has been on CAMS for about one and a half years. Their host base is at Grand Forks which is about

ninety miles away. They sent about twenty-five key people to the MTT at Grand Forks. The number sent was not near the twenty-five percent the MTT would like to have due to a limitation placed by the National Guard Bureau because of funding. The number of trained people was not rally adequate.

They developed a crash training program by taking the people who were the most dedicated in filling out the 349s and using them to train others in the organization. This training was conducted over a sixty day period. This training was given during the week and continued into the weekend. However, the number of traditional guardsmen trained was very small due to their availability.

About sixty percent of the unit is trained on CAMS with the majority being the full time technicians. The quality of training given the full timers is excellent and that given to the part timers, on balance, is very poor. The quality of the weekender's training depends upon the supervisor.

They are not aware of any FTD training available at the host base."

MSG Robert Wortham, Data Base Manager, 124 TRG, ANG

The 124th is not on CAMS yet. Their host will be Mountain Home AFB, and it is located about fifty miles away. The Chanute MTT is scheduled to come to the 124th and they are planning to send sixty-eight full-timers to the training. They do not intend to send any of the part time .

The 124th will not be able to use any of the FTD

training provided at the host base due to the large number of host base people requiring training.[10]

CMS George Wood, Data Base Manager, 192 TFG, ANG

They were the first Guard unit to use CAMS. Their host is Langley and they are about eighty miles away. When they went on CAMS the Chanute MTT was not available and it was a "catch as catch can" type of training. They have had no formal training in CAMS. The full timers are very well trained but the part timers are not. It is very difficult to train the part timer since they are only available two days a month and it is even harder to remember what training was given from month to month.[11]

SRA Robbin Click, Data Base Manager, 131 TFW, ANG

The 131st has been on CAMS about two years. They are hosted by Scott AFB which is about 35 miles away and have trained their full time technicians. They have trained their part timers but retention is a major problem. Only using the system once or twice in a thirty day period does not give enough exposure to the CAMS system. They have had training problems due to CAMS training being given before their equipment arrived. They did not use the MTT training but had an FTD instructor from the host base train their full time personnel. The reason they did not use the MTT at Scott AFB was because the host scheduled their training time on second shift and that is not feasible for ANG civil service technicians.[12]

Lt Rick Baize, Assistant DCM, 110 TASG, ANG

The 110th went on line with CAMS in June 1988. Their host is Wurtsmith AFB, located about 400 miles away. The Chanute MTT came to the 110th and taught the executive and MDC level courses. They had no problem getting their full time technicians trained. There were no part timers trained by the MTT.

The MTT course gives a good overview of the system but, as far as the integration and how it works in the squadron it is really lacking. There is no training on how CAMS works between maintenance control and debriefing. From an informational source the Chanute training is good; from an operational impact there is nothing available unless you get with another unit.

By virtue of the way the system operates, people are going to get trained on it. Just by making the inputs an individual will get trained. The big problem is where that information crosses lines of authority, and the flow throughout the maintenance organization. That is the area where they had to get help, especially with debriefing, job control, maintenance control, and dispatch. They believe it is a great system and are totally dependent on it.

There needs to be some type of transition or follow-up training after the MTT. Additionally, they feel there needs to be some training to deal with the high use areas like organizational maintenance, maintenance control, production analysis, engine tracking, and plans and scheduling. It

would help to have someone come in and set up the flow. The 110th has not used the FTD training.[13]

Mr. Rich Rico, NGB Program Manager for CAMS Training

CAI has been fielded, but only a few guard units are trying it. The 137th TAW, at Oklahoma City, is currently field testing the latest version of CAI. There were several problems with this training aid when it first came out. Supposedly those problems have been ironed out. NGB's us of CAI is primarily for the traditional guardsman because they don't get the other types of training. How good this system is, or will be, is difficult to tell because it isn't available on a general basis. The only training being used by the ANG is that provided by the mobile training team. FTDs are not used because guard units are not normally located on an active duty installation.

MTT provides good training but it really doesn't provide all the training needed. The training is too generic and doesn't give the guard units all they require. It doesn't provide specifics on the various aspects and programs that CAMS offers.[14]

SUMMARY

It is apparent that HQ/SSC defined a two phased training program, MTT and FTD, and ATC has implemented it. The concept of training twenty-five percent of the work force and using that cadre to train the remainder is not new and has been used successfully in the past. Where the disconnect or shortfall in training appears to be is in the nature of

trying to train the traditional guardsman.

The Mobile Training Team concept used for CAMS is not responsive to the user's need because of the large number of people to be trained and the short period of time to train them. If a unit is scheduled to convert to CAMS and they are not ready to convert they must go ahead and take the training offered by the MTT because it is virtually impossible to re-schedule it. In some instances there have been long delays between training and conversion. Guard units have found this delay to result in little or no retention of the MTT training.

For a couple of reasons the guard is not sending twenty-five percent of its maintainers to the MTT. First, there may not be enough slots available when the training is at a host base. Second, the National Guard Bureau (NGB) does not have the funds available. But even if they sent twenty-five percent of their full time technicians to the MTT it is not apparent to the author this would in any way help the training problem of the traditional guardsman. Sending the part timer to the MTT probably will not work either. There still is the problem of his availability, funding, and retention of information.

The basic problem is, the unit does not have the time to train the part timer in this system. It is quicker for the full timer to make the entry in the system than it is to take the time to train the part timer in making that entry. That is understandable when you take into consideration there

are flying schedules to meet and how can you expect an individual to remember the various computer screens from month to month.

Another problem facing the Guard is the timing of training and the conversion to CAMS. Training schedules are tight due to the large numbers of personnel to be trained for CAMS. Just because the equipment is not available does not mean you slip the training schedule. However, when there is a lag between conversion and equipment availability there will be a significant loss of information learned during training.

Guard units are not normally located on an Air Force base. In fact only three guard units out of ninety-one flying units are located on Air Force bases. So anytime a guardsman needs to partake of FTD training it is usually a TDY. There are some unique funding problems for the guard.

If all of this looks bleak, well it is. The traditional method of training, platform instruction, is not providing the training necessary for the traditional guardsman. This training must be based on his/her availability. It must not tie up a lot of the full time resources to conduct the training. The guard needs a training system that can be paced to the individuals needs. It must provide acceptable training in a short period of time and have a high retention rate. The training must be consistent from unit to unit.

CHAPTER IV

INTERACTIVE VIDEODISC

You can hear something a hundred times,
but it is better to see it once.
-- Old Chinese proverb

BACKGROUND

In Chapter I, I discussed the heavy reliance the Total Force Policy places on the traditional guardsman and the unique requirements of training the "weekend warrior". Chapter II, showed the importance of CAMS to the USAF and ANG. In Chapter III, I showed the training provided by ATC and the shortfalls of that training. Training shortfalls are not a problem created by ATC. In this chapter I will analyze an alternative method of training because it is obvious the current one, classroom lecture (platform instruction), is not doing the job for CAMS.

I will briefly summarize those training problems as follows:

- Enlistees not as well educated
- Hi-Tech (complex) weapon systems
- Rapid weapon system conversions
- Time demands on available training time is increasing
- Retention of information difficult -- no day-to-day use
- Formal ATC schools generally not available
- FTDs not used or not available

- Training at times other than normal UTA is not effective
- Job conflict
- NGB funding is limited

The ANG has a unique requirement and needs a specialized training program.

In years gone by training was a long and laborious process. To become a skilled laborer one became an apprentice to someone skilled in the particular field of endeavor. Basically, it was a one-on-one training process. This system worked quite well until technology caught up with the work place and the inefficiency of training one-on-one could no longer be tolerated. As single proprietorships grew into small companies and small companies grew into large conglomerates the need for training outstripped the capability of the teacher-student, master-apprentice environment.

NEW TECHNOLOGIES

Today, large companies are spending vast sums of money to provide training to their work force and up until now they were doing it through classroom training. Technology has entered the field of training and more and more companies are taking advantage of it.

Video tapes, films and slides have long been used for presentations and as training devices. They are tireless, all knowing, and consistent. In addition, these methods can be interfaced with a computer which allows the user to ask questions and make determinations. The user does not have to

be a skilled typist or data processing expert.[1] This, in essence, is computer-based training (CBT).

CBT, a one-on-one training system, is effective. It shows the computer's ability to ask questions, prompt for answers, probe the users understanding, and provide the opportunity to make choices and decisions. However, when the computer display is limited to textual material, an important means of presenting information is lost. Just looking at textual information will become boring.

Integrating the computer with a videodisc makes training more effective. Now the computer can add the stimulus of color, action, sound, and pictorial information. The user can still control his or her own rate of progress.[2] This system is called interactive videodisc (IVD) and consists of a personal computer (PC), extended graphics adapter (EGA), videodisc player, and an RGB color monitor. Different authors use different terms for these systems such as interactive video instruction (IVI). For purposes of this paper I will use IVD throughout.

The computer revolution has been key to most of the breakthroughs in the field of training. IVD technology, (not really new, has been around for ten years), is called "the ultimate educational tool." It ties together our love of television and the intrigue of the computer.[3]

As well as Americans relate to TV screens, IVD may very well invade the classroom much faster than did the computer. "It makes one-on-one training economical--and can

bring the best instructors face-to-face with any student who has access to an IVD system."[4] It combines the potential of many teaching devices.

IVD systems allow interactive teaching, learner control of materials, and minimal supervision. It can simulate reality, and provide an effective and inexpensive alternative to hands-on training. IVD systems are consistent because disc players can be installed almost anywhere, discs changed as necessary, and the same material can be taught at many locations.[5] They can be offered almost anywhere because there is no need for local expertise.

The main feature of an IVD system is its ability to inter-relate to the student. It requires the student to play an active part in the lesson. If a student believes he knows the material he can bypass that section and test immediately. On the otherhand, if he isn't sure, he can test, and based on the results, go forward, or return to a previous lesson. This interactivity allows the student greater freedom. By contrast, more traditional methods of training such as videotape and books are linear--all the material is presented in the same order to every student. The student becomes a passive observer by watching videotape and listening to lectures. This has been shown to be a much less effective learning role.[6]

RESULTS OF NEW TECHNOLOGIES

Chevron Information Technologies Corporation faced a challenge in training computer operators. The small number

of people involved at any one time did not justify holding classes, and CBT was boring. The answer was IVD. It was more lifelike than the conventional CBT, says Rick Garibaldi, a training analyst at the Chevron Corp. It also provided pizazz that made courses entertaining as well as educational. "They don't just sit and get vegged-out in front of the thing," Garibaldi says.[7]

Perceptronics Inc. of Woodland Hills, Ca developed an IVD training system for the Army for the TOW antitank missiles. The purpose of this project was to determine whether or not soldiers trained on a video screen could really be prepared for actual combat. The Army staged a test at Fort Benning, Ga using soldiers trained on the IVD system. The soldiers were given real TOW launchers and missiles with dummy warheads, then pitted against ten "enemy" tanks on a search-and-destroy mission. The soldiers were ten out of ten in the mock firefight. This suggests that each dollar invested in IVD simulators for TOW training could save $300, with no loss of tactical readiness, says Gershon Weltman, chairman of Perceptronics Inc.[8]

Weltman says the students using this simulator objected to the sluggishness of the system's controls. In fact, however, the system had been programmed to respond as slowly as the actual equipment. Thus the students learned the necessary compensation. After the army began to use this simulator they won the annual tank-gunnery competition with Canada for the first time in years.[9]

Another system using IVD technology to train people in cardiopulmonary resuscitation (CPR), was developed by David Hon, Director of Advanced Technology Development at the American Heart Association. In this system the IVD is linked to sensors embedded at strategic locations in a lifesize mannequin. These sensors automatically measure and evaluate the student's performance of the CPR techniques shown on the video screen by a human teacher. Feedback continues until the student has mastered all aspects of CPR.[10]

The CPR system shows the potential of interactive videodisc training. Recent studies involving three different kinds of testing, by three independent research organizations, report this training significantly more effective than live instruction.[11]

Richard Cavagnol, Director of Product Development for the Training Systems Division of WICAT, conducted an informal evaluation of IVD training at the Army's Air Defense School, Fort Bliss, Tx. An IVD simulation, created by WICAT, covered twelve hours of a 26-week course on maintaining a HAWK missile battery. Cavagnol says the results were similar to the CPR system.

> The developers tested mechanics trained in classrooms and on actual equipment against those who used the interactive videodisc. Of seventeen students taught by traditional methods, fourteen could not begin to solve the exam problem; three took more than twelve minutes. Yet all twenty students who went through the videodisc program solved the problem in less than four minutes.[12]

In another example, Frank Savely, Chief of the Computer-Based Training Division for the Defense Logistics

Agency (DLA) Systems Automation Center (DSAC) needed to immediately train more than 400 employees, at several widely dispersed sites, in a new computer language, and at the lowest feasible cost. Savely convinced the DLA, Intra-Agency ADP Training office in Columbus, Oh., to invest in an IVD training course, which now saves the agency more than $6,150 a person in training expenses.

DLA enrolled thirteen of its technicians in a three-week, vendor-conducted UNIX course. The cost of the course was about $6,400 per student including per diem. The total cost was $83,000. After investigating the functionality and cost of other programs, DLA realized that as many as 400 employees at several locations could receive UNIX instruction in-house for an overall cost of $96,000, or as little as $250 per person, by using IVD. Savely said, "In only nine months, we have been able to effectively train 400 employees on the UNIX system, without the monetary or time expense involved in transporting personnel to classes away from the office."[13]

General Motors (GM), in cooperation with United Auto Workers (UAW), compared IVD training to classroom training. They developed a hazardous materials training course using both methods. A nine module IVD course was developed and a classroom version of the same nine modules along with a comprehensive instructors guide for conducting classroom training was also produced. The following guidelines applied:

- 209 workers from fifteen GM plants in midwest
- Participants had no previous training on these

modules

- Classroom training used an expert trainer who followed carefully developed procedures
- Course knowledge and attitude toward training were tested

To ensure objectivity, an outside consultant, Dr. James Bosco, Director of the Merze Tate Center for Research and Information Processing, at Western Michigan University, was used to evaluate the two systems.

Dr. Bosco's evaluation showed positive results for IVD. When compared to "best case" classroom training the IVD produced more learning. A sixteen point test was used and the IVD group scored thirteen while the classroom group scored ten. The IVD group scored twenty-six percent better.

Interestingly enough, most of the workers with the highest scores were trained using IVD. Most of the workers who scored lowest, were in the classroom training group.

The evaluation showed all workers performed equally well on the IVD system. Age, sex, amount of education, and years of employment at GM did not limit their success in training. The attitudes toward the IVD system were not affected by any of the above factors. All members of the groups were highly positive.

An area of concern was how the workers felt about IVD training. The results follow:

- Of the two training methods, attitudes about IVD most positive.

- Eighty percent preferred IVD to classroom.
- Seventy percent felt it was easier to pay attention to IVD
- Seventy-eight percent felt they learned more from IVD
- Ninety-eight percent felt it was easy to use IVD

The last area to be evaluated was time to train using both IVD and classroom. The average time to complete the IVD instruction was 33.87 minutes/student. The average time to complete the classroom instruction was 33.25 minutes/student. The difference is minimal.

The GM/UAW evaluation concluded:

- IVD very effective in achieving training objectives
- IVD strongly preferred by workers
- IVD competitive with the classroom in training time[14]

Goodyear Tire and Rubber Company recently compared its IVD system (*Activ*), developed by Industrial Training Corporation, (ITC) with videotape and instructor-based training. To prevent biasing, the training and testing were done by Goodyear personnel, Kyle McCain and John Hensley, of the Tyler, Tx branch.

This study was to determine the effectiveness of IVD training in terms of performance, training time, and trainee attitudes. They evaluated both initial and follow-up training, and used journeymen mechanics with little or no formal

training in electrical/electronic skills. All students were being trained in the use of an oscilloscope and a multimeter. Participants in the study were volunteers, with a total of nine trainees taking part in the study.

Prior to start of the project all participants were given written tests and evaluated on performance tasks. The tests were locked away without any grading to preclude biasing.

Using a random technique the students were divided equally into three groups. Each group received initial training either through IVD, videotape, or instructor-based classroom training.

Upon lesson completion trainees were given a written test and another set of performance tasks. The effectiveness of each training method was based on comparisons of pre and post test scores, and performance task evaluations.

Each group was scheduled for follow-up training using the other two methods of instruction. The purpose of the switch was to give each trainee exposure to all three training methods. This allowed evaluation of trainee attitudes toward each method. A by-product was to evaluate the effectiveness of using each method as follow-up training. At the conclusion of each follow-up lesson, trainees were again administered a written post-test and performance task evaluation so that any improvement could be noted.

At the end of this study trainees and instructors were surveyed to determine their attitudes toward each train-

ing method. The results indicated that when IVD was used to present initial training, trainee performance was superior to the performance of trainees using videotape, and approximately equal to the performance of those trainees taught by an instructor. When each method was used for follow-up training, IVD proved to be the most effective.

Student's summary:

- With each lesson limited to two hours IVD may be faster.
- Classroom students complained material covered too fast
- IVD students felt time was adequate
- IVD protects trainees from embarrassment of giving wrong answer
- If only one method available for training, IVD the overwhelming choice

Trainer's summary:

- Not enough time to cover material
- IVD may reduce overall training time[15]

IVD is widely viewed as more effective than conventional CBT, videotapes, or other media-based training. However, experts disagree on whether IVD is more effective than classroom training with an instructor. Rockley Miller, publisher and editor of the newsletter *Videodisc Monitor*, believes for subjects such as data processing training, live instruction can be superior "If you have the best instructor, and a tightly organized course."

He concedes however, that live instruction can be passive for students. Interactive video engages students, helping them retain information. It also lets them bypass familiar parts and concentrate on the ones they have trouble with.[16]

Trainers have not jumped on the band wagon for IVD. Even when interactive video is judged a viable alternative to classroom training, trainers often view it as a complement rather than a substitute, says Natasha Thomsen, a research associate at Link Resources Corporation in New York.[17]

That is the approach at The Hartford Group, which uses off-the-shelf interactive video courses says Terri Pawlowski, Director of Technical Training at the insurer's Information Management Department.[18]

Jill Lawrence, an Associated Press Writer, reported on a twenty year study conducted by the National Assessment of Educational Progress. The study indicated the traditional method of teaching, classroom instruction, is turning out students with little more than basic skills.[19]

The report said

> It is apparent that fundamental changes may be needed to help American schoolchildren develop both content knowledge and the ability to reason effectively about what they know -- skills that are essential if they are to take an intelligent part in the worlds of life and work.[20]

The report indicated part of the problem is in authoritarian teachers and passive learners. The study showed that more homework, more course work, and higher per-

formance standards are the solution.[21] Their solution, in this author's opinion, is off the mark. Educators are not accepting instructional methods that depart from traditional standards.

There are many more praisers than detractors of IVD. "Good IVD is the equivalent of a private, infinitely patient, engaging, and totally knowledgeable tutor for each student".[22] By mixing technologies such as videodisc, audio, graphics, text, and computers, IVD requires students to become involved -- active rather than passive. They are reacting every few seconds.

Additionally, *branching* allows the students to shorten their learning time by allowing them to tailor their training to their particular need. No two students ever go through a course in the same way.[23]

A study conducted by Judith Vadas, Program Manager for Educational Technology at IBM Corporation, pointed out the effectiveness of interactive video. In an internal IBM study the use of interactive video showed the percentage of students reaching mastery (eighty percent on the post-test) increased more than 300 percent over the lecture-based classroom training.[24]

An article in the *Training and Development Journal*, "Understanding Interactive Video," December 1983, said, "trainers generally agree that people retain about twenty-five percent of what they hear, forty-five percent of what they see and hear, and seventy percent of what they see,

hear, and do. Interactive video programs keep the learner seeing, hearing, and doing."[25]

Why IVD works -- Concentrated learning

Allen D. Glenn, Professor of Education at the University of Minnesota says, "students are more task-oriented and spend more time directly working with the materials. Consequently, learning takes place in less time." He believes it is because of the concentrated learning it imposes.[26] In one example, the U.S. Army Signal Center compared interactive video simulations for training against other methods and showed the interactive videodisc group mastered the skills in twenty-five percent less time.[27]

Diane Manning, Chairperson of the Department of Education at Tulane University, and Donald Ebner of the U.S. Army, in their article, "Videodiscs Can Improve Instructional Efficiency," found during an Army test "the videodisc instructors saved three hours from the original schedule, completing the lesson in four hours rather than seven." That is a forty-three percent reduction in training time over classroom scheduling.[28]

In a report published in the *Wall Street Journal* on February 15, 1985, Digital Equipment Corporation found workers learned lessons forty-five percent faster with IVD than they did when they traveled to a centrally located, company training facility, and learned, using traditional methods.[29]

Why IVD works -- Increased content mastery

IVD is rated high at AT&T. In a survey of forty-four branch managers the following statistics emerged:

> Eighty percent felt it was more effective than videotape; none felt it was less effective.
> Eighty percent felt it was more effective than slide presentations; none felt it was less effective.
> Eighty-two percent felt it was more effective than printed text; none felt it was less effective.
> And most significantly, seventy-six percent felt it was more effective than live classroom instruction, while only three percent felt it was less effective.[30]

Test after test show IVD trained students have better mastery of the required skills as the following quotes reveal:

> On initial performance testing, 83 percent of the videodisc group passed - a rate that was eight percentage points ahead of historical average...On delayed posttesting...75 percent of all videodisc trainees were successful; only 59 percent of the control group (classroom) students were successful.[31]

> The largest collection of evaluation studies has been conducted by the U.S. Army. An experiment at the U.S. Army Defense School compared classroom, computer, and interactive video simulations for maintenance training...The results showed that the interactive videodisc group took half the time to solve repair problems.[32]

> Three times as many of the students who had the videodisc training passed as those who had taken the instructor based training. In addition, <u>all</u> videodisc students took less time than <u>any</u> of the students in the regular class.[33]

Why IVD works -- Methodology

IVD follows the principles of most modern learning theories. An effective training program, whether IVD or classroom, will have these key elements, tutorial, simulation, modeling, practice, testing, reinforcement, feedback, and remediation.

These elements are greatly enhanced by the use of IVD.

Tutorial: Presented in short segments.

Simulation: IVD can simulate any action or reaction needed to make a point.

Modeling: Examples of correct way; copy the expert.

Practice: Re-enactment of proper procedure or behavior.

Testing: Pre-test. formative and summnative testing utilized.

Reinforcement: Confirm the correct response or behavior.

Feedback: Immediate advice on correct or incorrect answer.

Remediation: Correction by example.[34]

The fact that learners are active as opposed to passive when using IVD contributes to the learning cycle. An article in the Science and Technology Section of *Business Week*, September 1987, states the case for IVD very clearly.

> 'Proof in the Pudding.' The reason IAV works so well is that people learn more through sight than all of the other senses, according to experts. And the instant feedback intensifies the learning process by reinforcing each step of the lesson. By marrying the personal computer and the videodisc, training can be made more personal and realistic than is possible in conventional classrooms. Massachusetts Mutual Life Insurance Company's director of field development, Jane C. Curtis, observes that studies have shown that IAV shortens learning time by as much as 50% while increasing retention by 80%.[35]

SUMMARY

Throughout this chapter I have shown numerous examples of the success of IVD Training. There are a few who disagree with the merits of IVD but, the companies using IVD sing its praises loud and clear. Ford has installed interactive videodisc training systems at 3900 of 4700 dealerships to teach sales and repair techniques.[36] Interactive videodisc systems have also been used on a large scale by the state of Florida in training 8000 social welfare workers.[37]

To this author it is apparent an interactive videodisc training system will provide the following:

- Training at least as good as classroom training
- Training that is consistent from organization to organization
- High retention rate
- Paced to the student's need
- Needs little or no trainer supervision
- Significantly shorter training time.
- Readily available

The most significant advantages of IVD are, the reduction of learning time (up to fifty percent less time), and the increased retention of lessons learned (up eighty percent knowledge retention).

CHAPTER V

CONCLUSION AND RECOMMENDATION

The Core Automated Maintenance System will be fully implemented and installed at all USAF, ANG, and Air Force Reserve installations by late 1991. It is a system of significant importance because it saves dollars, time, and can improve a unit's combat capability by providing timely, and accurate information regarding aircraft maintenance matters.

The Air National Guard can do a better job of training traditional guardsmen in this system. Currently, training is provided by a mobile training team, with follow-up training provided by a field training detachment. This approach works well for the full time guardsmen but is lacking for the weekenders. Classroom training for CAMS is not adequate because of scheduling problems, funding problems, and retention of information.

In chapter IV the author identified an alternative method to standard platform or lecture instruction. Interactive videodisc is a proven method and IVD looks like it was tailored for the guard. It meets all of the unique requirements of training the part time guardsman because of the following features:

Up to fifty percent faster. With all the various administrative functions demanding the guardsman's time it is important to get the most training possible in the shortest amount of time. Chapter I, Table 1, showed the limited

amount of training time available to the traditional guardsman. All studies of IVD show it to be a faster training device than classroom instruction, as high as fifty percent faster.

Up to eighty percent retention rate. In one case with the Army, students who had not seen or trained on the actual device, scored higher in all live tests than those who were trained using classroom instruction and hands-on training.

It will always be difficult to retain information when it is used only once or twice every thirty days. IVD significantly increases retention rates which will help this problem. It will not alleviate it but it will greatly reduce the problem.

No supervisory involvement. A problem with the system in use today is supervisor involvement. They do not have the time to give individual attention. The supervisor has time constraints due to flying schedules and his own administrative requirements. IVD requires no supervisory involvement.

Can be used at any time. Scheduling training for the part timer is a major problem. As I stated earlier there are many administrative demands for the part timers time. Additionally, the traditional guardsman does not always attend the normally scheduled training assembly. He may be scheduled by the unit on an off-weekend. He also may be sick or have a job conflict. IVD allows the student, when performing

duty at other than normal training assemblies, to get the same training that was provided at the scheduled unit training assembly. Again, the supervisor is not involved.

Work at students pace. Some students learn faster than others and all have different levels of knowledge. IVD allows each student to progress at his own pace. If he knows a particular part of the lesson he can skip that and go to the next part. If he needs remedial training on one aspect of an involved system he can easily do that. Tests have shown that no two students ever go through an IVD instruction course in the same way. It is like having your own personal instructor.

Consistent training from location to location. A problem with classroom instruction, and an even larger problem with students training students, is consistency of training. It is very easy to interject an instructors personal bias. IVD provides the same instruction to every student at every location.

No case rated IVD less effective than classroom. In all cases reviewed by the author, with the exception of one, IVD was rated better than classroom instruction. That one case stated that IVD was "at least" as good as classroom instruction. IVD is a proven technology and its use is becoming widespread in the military, government, and private industry.

Congress places a heavy reliance on the reserve forces. The ANG no longer has the luxury of three to six

months training time after mobilization. Many units are tasked to be in-country within seventy-two hours after mobilization. Therefore, it is imperative that guard personnel, both full and part time, are highly trained prior to mobilization. IVD technology provides the method to effectively train the guardsman because of the reduction in learning time and the increased retention rate.

The ANG, in the author's opinion, should begin immediate development of an IVD training program for the Core Automated Maintenance System. This system is so significant in its ability to enhance war fighting capabilities, the Air National Guard should invest the time, effort, and money to ensure all maintenance personnel are well trained in its use.

A task force should be designated to develop CAMS IVD training. This task force should consist of representatives of the ANG aircraft maintenance organizations, personnel knowledgeable of IVD technology, and representatives from HQ/SSC (the developer of CAMS). The task force should be headed by someone with foresight, aggressive leadership, and full support of the command structure of the Air National Guard.

No attempt has been made to analyze costs of an IVD system. That is beyond the scope of this paper. Suffice it to say the major expense will be in preparing the videodisc. The hardware is already available in each of the ninety-one ANG flying units.

NOTES

INTRODUCTION (Pages 1-8)

1. Dr. Charles J. Gross, Prelude to the Total Force: The Air National Guard 1943-1969, U.S. Government Printing Office, Washington D.C. 1984, 7.

2. Ibid., 23.

3. Ibid., 59-73.

4. Defense 88, "Contribution by Air Reserve Forces To the Total Air Force", U.S. Government Printing Office, Washington D.C., September/October 1988, 18.

5. Interview with Lt Col Andrew (Woody) Woodcock, January 26, 1989. Col Woodcock is the Chief of the Programs Support Division in the CAMS Program Management Office. He has been in this position for the last two and a half years. Prior to this assignment he was Chief of Communications and Operations at Yakota AFB, Japan.

CHAPTER I (Pages 9-22)

1. Ibid., Gross, 156 to 157.

2. Ibid., 157.

3. Interview with Brig Gen Bunting, Kansas Assistant Adjutant General for Air, Topeka, Kansas, May 1, 1987, October 13, 1988, November 29, 1988, January 20, 1989, and March 4, 1989. General Bunting was Chief of Personnel for one of the units that deployed to Korea. He later served as Chief of Staff to the Director Air National Guard, National Guard Bureau, Pentagon, Washington D.C.

4. Interview with CMS Robert D. Nichols, Chief of Maintenance Control, 184TFG, Rosehill, Ks., May 5, 1987. Chief Nichols was a full time aircraft maintenance technician with one of the units that deployed to Korea. He later retired as Chief of Maintenance Control, 184 TFG, McConnell AFB, Ks.

5. Bunting intvw.

6. Nichols intvw.

7. Bunting intvw.

8. Interview with Col Fred Helms, ANG, Assistant Adjutant General For Air, Al, January 17, 1989. He is a former Commander of the Air National Guard Support Center, Andrews Air Force Base, Md.

9. Bunting intvw.

10. Interview with Lt Col Stephan Gray, Chief of Recruiting and Retention ANG, Andrews Air Force Base, Md, May 15, 1987.

11. Bennie J. Wilson III, ed, The Guard and Reserve in the Total Force, [Washington 1985], 104.

CHAPTER II (Pages 23-42)

1. Interview with Col Philip Engstrom, Director, CAMS Program Management Office, Headquarters Standard Systems Center, Gunter AFB, Al, October 12, 1988, November 16, 1988, Deccember 19, 1988, January 20, 1989, and March 4, 1989. In previous assignments Col Engstrom has been an AT-38B Instructor pilot, Chief, Maintenance Training Management Division, Component Repair Squadron Commander, and an Assistant Deputy Commander for Maintenance.

2. Interview with Lt Col Bob Bryan, October 12, 1988 and March 4, 1989. Col Bryan is the Chief of the Functional Management Branch for CAMS. Prior to this assignment he was Chief of CAMS Quality Assurance Division. Before his involvement with CAMS he was Test Director at Fort Huachuka for TRI-Service Tactical Communications.

3. Interview with Capt Bob Dickmeyer, Chief CAMS Micro Computer Development Branch, January 20, 1989. Prior to assignment to HQ/SSC Capt Dickmeyer was an Aircraft Maintenance Officer with the Military Airlift Command.

4. Woodcock intvw.

5. Interview with MSG Kathlyn Pegg, CAMS Functional Analyst, January 25, 1989. MSG Pegg is the resident expert on CAMS training at HQ/SSC Gunter AFB, AL. She has been a CAMS Functional Analyst for the last four and a half years. Prior to her CAMS assignment she spent ten years as a Maintenance Systems Analyst. MSG Pegg is thoroughly familiar with aircraft maintenance, CAMS, and CAMS training.

6. Pegg intvw.

7. Engstrom Intvw.

CHAPTER III (Pages 43-60)

1. Engstrom Intvw.

2. Pegg intvw.

3. Interview with Capt Kevin Illsey, Training Staff Officer, Headquarters, Air Training Command, January 26, 1989.

4. Interview with Mr. Rich Mauer, CAMS Training Manager, Mobile Training Team, Air Training Command, Chanute AFB, January 26, 1989.

5. Interview with SMS Mattew Sanders, 3785 Field Training Wing, Sheppard AFB, January 26, 1989.

6. Interview with MSG Robert Barrett, Data Base Manager, 184 TFG, McConnell AFB, Ks, January 27, 1989.

7. Interview with MSG James Alber, Data Base Manager, 190 AREFG, Forbes Field, Topeka, Ks, January 27, 1989.

8. Interview with MSG Joe Forehand, Data Base Manager, 187 TFG, Dannelly Filed, Montgomery Al, January 27, 1989.

9. Interview with SMS Clayton Brennan, Data Base Manager, 119 FIG, Fargo Nd, January 29, 1989.

10. Interview with MSG Robert Wortham, Data Base Manager, 124 TRG, Boise Airport, Boise Id, January 29, 1989.

11. Interview with CMS George Wood, Data Base Manager, 192 TFG, Byrd Field, Richmond Va, January 29, 1989.

12. Interview with SRA Robbin Click, Data Base Manager, 131 TFW, Lambert IAP, St. Louis Mo, March 21, 1989.

13. Interview with Lt Rick Baize, Assistant Deputy Commander for Maintenance, 110 TASG, Billy Mitchell ANGB, Milwaukee Ws, January 29, 1989.

14. Interview with Mr. Rich Rico, NGB Program Manager for CAMS training, ANGSC, Andrews AFB, Md, March 9, 1989.

CHAPTER IV (Pages 61-77)

1. "Interactive Video Systems for Training", Unisys Federal Information Systems - Phase IV Branch, No Date.

2. Ibid.

3. Richard L. Currier, "Interactive Videodisc Learning Systems", High Technology, Nov. 1983, 51.

4. Robert Neff, "Videos are Starring in More and More Training Programs", Business Week, Sept 7, 1987, 110.

5. Ibid., Currier, 51.

6. Ibid., 51.

7. David A. Ludlum, "The Training That Talks Back: Interactive videodisc instruction can be potent, but consider the cost", Computerworld, August 15, 1988, 101.

8. Ibid., Neff, 108.

9. Ibid., Currier, 55.

10. Ibid., 53.

11. Ibid., 53.

12. Ibid., 53.

13. "Interactive Video Course Cuts ADP Training Costs", Government Computer News, August 14, 1987, Software Section, page unknown.

14. UAW-GM National Joint Committee on Health and Safety, "A Report on the Evaluation of Interactive Laser Disc System Instruction for Hazard Communication Training at GM", April, 1988

15. Sheila Holzberger, "Findings from Goodyear, Goodyear Tire Compares ITC *Activ* with Traditional Training Methods", The Videodisc Monitor, Falls Church, Va ,March, 1987, 14-15.

16. Ibid., Ludlum, 101.

17. Ibid.

18. Ibid.

19. Jill Lawrence, "Students Gain Basic Skills, But Little Else", The Montgomery Advertiser, February 15, 1989, 1A and 12A.

20. Ibid.

21. Ibid.

22. John Woolsoncroft, "Interactive Video and Your Budget", Data Training, Weingarten Publications, Inc. Boston, Ma, February, 1987.

23. Ibid.

24. Judith E. Vadas, "Interactive Vidoedisc for Management Training in a Classroom Environment", IBM Corporation, Armonk, New York, no date.

25. "Understanding Interactive Video", Training and Development Journal, December 1983.

26. "Teaching Economics: Research Findings From A Microcomputer/Videodisc Project," Educational Technology, March 1984.

27. W. D. Ketner, "Proceedings Of The Conference On Videodisc For Military Training And Simulation," Society For Applied Learning Technology, 1982.

28. Diane Manning, Chairperson of the Department of Education at Tulane University, and Donald Ebner of the U.S. Army, co-authors of "Videodiscs Can Improve Instructional Efficiency," Instructional Innovator, September, 1984

29. Delbert Lippert, Digital Equipment Corporation, Wall Street Journal, February 15, 1985.

30. Marvin Goldberg, Division Manager for Technical Support Planning at AT&T, "Survey Shows Disc Training Works Well At American Bell," E-ITV, June, 1983.

31. Ibid., Manning.

32. D. A. Kimberlin, "Proceedings of the Conference on Videodisc for Military Training and Simulation," Society for Applied Learning, 1982.

33. "Design Factors for Successful Videodisc-Based Instruction," Educational Technology, March 1985.

34. Vicki Vance, Director of Interactive Technologies for Deltak Training Corporation, "Back to the Drawing Board, The Promise and Challenge of Interactive Instruction", Deltak Training Corporation, 4.

35. Ibid., Neff, 108.

36. Ibid., Currier, 54.

37. Ibid.

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